THE

AMERICAN NATURALIST.

VOL. XX.—*FEBRUARY*, 1886.—No. 2.

THE POST-MORTEM IMBIBITION OF POISONS.

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THE subject is one not only of a highly interesting character to the scientific observer, but also an important one from its medico-legal aspects. Perhaps the questions which very naturally first arise, viz., What is its nature and what are its medico-legal relations? can be best answered by the following hypothetical case, which it is hoped will serve to illustrate the subject in a manner best calculated to aid in its thorough comprehension.

Suppose a person dies of a natural cause, and is buried in the usual manner in conformity with the established customs of his country, the body to all external appearances not having been tampered with. Also, that, after the lapse of a few weeks, an individual who had previously introduced into the body, per mouth or rectum, a poison or poisonous solution for the purpose of accusing an innocent person of a horrible crime, should quietly circulate a report that the deceased had been poisoned, and intimate that the crime had been committed by such and such a person. With what remarkable lightning rapidity does a report of such a sensational character as this travel from one individual to another, rarely ever finding the doors barred, the contrary being the rule! This report would in a short space of time reach the tribunal of justice, cognizance would be manifested by the proper authorities, who would order the body to be exhumed, the various organs removed and given in charge of a reliable expert, who would subject them to a chemical analysis, which

[1] Inaugural thesis presented to the Faculty of the Medical Department, University of Pennsylvania, A. D. 1885.

would reveal the presence of the suspected poison. The subject is not of very recent date as many are led to suppose from the meagre account given, if given at all, in some of the standard text-books on toxicology of the present day. As far back as the time of Orfila, when he swayed as chief of the toxicologists, was the subject known, and indeed it appears that almost cotemporaneous with the birth of toxicology, already an account of the subject appeared.

In order to see in what light the subject was regarded in former times, extracts from the writings of a few authors will be here made, as to go over them all would involve a great amount of unnecessary labor. How eloquent is the language of Orfila on the subject, and in what an exceedingly small number of words does he illustrate the whole subject (Orfila on Poisons). He writes: "Suppose some wretch, with the design of accusing an innocent person of the crime of poisoning, should introduce into the digestive canal of a dead body a poisonous solution, which would afterwards penetrate by imbibition even to the remotest organ from which it would be subsequently extracted by the experts, and would lead them to the conclusion that they were dealing with a veritable case of poisoning." From the following it will be readily seen that the celebrated chemist, Sir Robert Christison, although not in possession of any evidence of crime having been practiced, yet was fully aware of the circumstances under which it might perchance be committed. Says Christison: "Although I have never been able to find any authentic instance of so horrible an act of ingenuity having been perpetrated, it must nevertheless be allowed to be quite possible."

The realization of the greatness of the crime does not seem to be apparent to the wretch who is meditating the commission of it, brooding over the insults of another, and holding malice against a fellow-man or especially (as it affords a better chance for the full performance of his crime), against one of his relatives, and ravenously seeking retaliation; for if it was realized, how is it possible that an individual, capable of the perception of right and wrong, living in society, constituting a part thereof, mutually dependent on and coöperative with his neighbor, could use such means for the wicked furtherance of his ends?

That there have existed in times past among the communities of the civilized nations of the world, individuals who have har-

bored such hatred toward their fellow-men that they have not faltered in carrying their intentions into practice, is manifested by the defences set forth in the trials of various murder cases, which are recorded in the annals of the tribunals of justice, not only of the New but also of the Old World.

That in a number of murder cases the defence has been that the poison was designedly introduced into the dead body for the purpose of crimination is made apparent by the narration of the following cases: Professor John J. Reese, M.D., in his article on the Post-Mortem Imbibition of Poisons (Transactions of the College of Physicians and Surgeons, 1877), relates a remarkable case of alleged arsenical poisoning, which occurred in one of the Western States. The suspicions were exceedingly strong that the poison was introduced after death for various reasons. The old man having been treated in his last illness for phthisis, his physician testifying to his having died of this disease, and to his having presented no symptoms of arsenical poisoning before death.

The body was buried four (4) years, during which time no suspicion of foul play appears to have been entertained. In the meantime, the widow again married, and the suspicion of poisoning was bruited about. The woman was accused of the crime, the body was exhumed, and a chemical analysis revealed the presence of this poison in the stomach and liver.

The defence was that the poison was designedly introduced into the body not very long before the disinterment, the body being kept in a vault. The case, singularly enough, having had a preliminary hearing, was abandoned.

Illustrative of the same, we have an article by Dr. Victor C. Vaughan (physician and surgeon, Ann Arbor, Michigan, Aug. 1883): " During the past six months there has been tried in this State a murder case, in which the question arose whether arsenious oxide could diffuse after death, after it had been mixed with water, and injected into the rectum or mouth or both."

Since direct experiments by others, and by the author himself, as will be seen hereafter, seem to prove that the absorption of poisons after death does take place, it must necessarily become an important factor how in such cases to differentiate ante-mortem from post-mortem poisoning. The methods are very limited. Perhaps the most reliable as well as the most con-

clusive evidence of ante-mortem poisoning are the symptoms manifested by the patient before death. Of little less importance is the revealing of the presence of the poison by chemical analysis in the interior of a large organ, as for instance, the liver; since it does not appear to be likely that a poison introduced after death could penetrate by imbibition even to the interior of so large an organ. That Professor Reese attaches much importance to the detection of the poison within organs will become evident by the following extract from the article before mentioned. Says Professor Reese: "If the poison were found on the exterior of the organs only, and not in their interior, after a careful research, I should regard it as a true case of 'Post-Mortem Imbibition.'"

In this connection a digression may be allowable relative to the impregnation of a dead body from arsenical soil into which it is sometimes unfortunately placed. In those cases, where owing to suspicions of poisoning it becomes necessary to disinter a body for legal purposes, it is often found that the coffin in which the remains are deposited has burst open, thus allowing the contents to come in contact and mingle with the soil (which in some rare instances contains arsenic). At the trial of these cases the counsel for the defendant, hard pushed for a defence, and whose only resource lies in a choice between "insanity" and "arsenical impregnation from the soil," in some cases selects the latter. The actions of lawyers in setting forth such groundless defences, being cognizant of the impossibility of the transudation taking place, and living in the light of present scientific knowledge, might be looked upon as of doubtful propriety. Unfortunately, in order to show that such a course is frequently pursued, it is only necessary to search the actions taken by the Commonwealth in the trial of cases of this nature, when it will be found that along with a chemical analysis of the organs, there is made also a chemical analysis of the soil. Indeed, this mode of action was taken in a recent case of arsenical poisoning occurring in this city (Philadelphia), in which the prisoner, although twice convicted, has not as yet been sentenced, on account of the existence of some of the so-called "technicalities." From the following opinions of certain toxicologists who have made it a study, it will be seen that it is regarded as impossible for this contamination to take place.

Professor Reese (Proceedings of College of Physicians and

Surgeons, 1877) says: "In the few cases in which arsenic has been discovered in cemetery soils, it has invariably existed in the insoluble state generally in combination with either lime or iron. Indeed, it cannot be extracted from such soils even by boiling water, but the agency of hydrochloric acid is required to render it soluble; consequently, it is impossible that arsenic should be capable of transudation from the soil into a dead body."

This assertion is corroborated by the direct experiments of Orfila (Acad. of Med., June 29, 1847), who showed that bodies buried in arsenical earth for a period of three (3) months, did not acquire any arsenical impregnation from arsenical soil. But even admitting that it is possible for a body to become impregnated from arsenical soil, it could be easily determined in case a body contained arsenic, whether it derived the poison by contamination with earth, or whether the poison was introduced into the body; by taking two samples of earth, one from the immediate contact with the coffin, and the other from the same strata, but in an adjacent portion of the cemetery, and subjecting both to a chemical analysis; if the analysis revealed the poison in the coffin soil, and not in the adjacent soil, then it would be evident that the soil was contaminated by the body and not the body by the soil.

With a view of determining whether it is possible for a poison introduced into a dead body, to penetrate through the various organs, and be recovered by chemical analysis, a series of experiments were conducted.

A small dog was killed, and into the stomach was introduced, by means of a flexible catheter, two ounces of water containing twenty grains of arsenious oxide. The animal was placed in a pine box, buried, and at the expiration of sixty days was exhumed. The following organs, viz., the stomach, liver, kidneys, lungs, heart and brain, were then removed. On the surface of the organs were observed brownish-black spots. The organs were found to be in a remarkable state of preservation, especially the kidneys. The brain was only slightly broken down, but the dura mater was intact. A bright yellow spot of the size of a small pea was observed on the urinary bladder.

The organs removed were placed in separate glass jars, and then subjected to a chemical analysis. The process employed for the recovery of the arsenic being the "Frenious and Babo" or

the hydrochloric acid and potassium-chlorate method, with the purification method of Otto. These are as follows: "The organ is cut into small pieces, and hydrochloric acid and water added. The mass is heated to near but not quite the boiling point on a sand bath. Potassium chlorate is added, in portions, the mass being stirred continually. The chlorine evolved disintegrates the organic matter. The mass is stirred and heated until all the chlorine is driven off, and it becomes homogeneous. The volume is kept up by adding water. Allow to cool and transfer to a moist linen strainer, and strain until the filtrate is clear, restraining all that is turbid. The residue is washed well with water. The arsenious oxide has been oxidized by the potassium chlorate to arsenic oxide. Reduce to arsenious oxide by adding an excess of a solution of sulphurous acid gas, the excess of gas being known by the odor.

The mass is evaporated to twice the volume of hydrochloric acid used; cool and filter if necessary. Thoroughly saturate while warm with a washed stream of sulphuretted hydrogen, which will throw down the arsenious oxide, organic matter, sulphur and the sulphides of other metals. Filter, wash the residue until the washings are free from chlorine. The residue is washed with a few c. c. of water containing ammonium hydrate. The sulphide of arsenic will be dissolved by the ammonia water and pass through. Evaporate to dryness in a water-bath, and add a few drops of nitric acid to destroy the organic matter; the nitric acid will also oxidize the sulphide of arsenic to arsenic oxide. Evaporate to dryness and repeat until the mass has a yellow color. To the dry residue add a small quantity of a solution of potassium hydrate and powdered carbonate of soda, and evaporate again. The potassium hydrate will combine with the arsenic oxide, forming potassium arsenate. Evaporate to dryness, and add three or four drops of concentrated sulphuric acid. Heat on naked flame until vapors of sulphuric acid cease to arise. The sulphuric acid will clear the organic matter. Pulverize the residue if necessary, add 25 c. c. of water, and one drop of sulphuric acid to acidulate. Boil and filter. The filtrate which contains arsenic oxide should be *colorless.* Reduce arsenic oxide to arsenious oxide by an excess of a solution of sulphurous acid. Concentrate until all of the sulphurous acid is gone, and about 20 c. c. remain.

The reagents employed in the extraction of arsenic, themselves

frequently contain this substance, notably those of zinc and sulphuric acid; hence, it becomes necessary to test all reagents to determine that they are absolutely free from this poison. None but "chemically pure" reagents were employed, the sulphuric acid being found to be such after subjecting it to Marsh's test. On the application of Reinsch's test to the hydrochloric acid and copper foil, they also proved to be reliable. *Summary of results obtained by chemical analysis of the organs removed from dog containing arsenic:* The extracts obtained from the stomach, liver, kidneys, lungs, heart and *brain* were subjected to Reinsch's test, and from *all of these organs arsenic* was recovered. In each case a sublimate was obtained on the side of the reduction tube, which, placed under the microscope, revealed the presence of arsenic by exhibiting many beautifully formed octohedral crystals. It should be remarked that the results obtained from the examination of these organs were about equally striking, with the exception of the brain, which gave somewhat less marked reactions.

On examining the literature of the subject of the "Post-mortem imbibition of poisons," it will become apparent that it has not received the amount of attention it so justly deserves. Indeed, so far as the writer has been able to learn the only investigations pertaining to the subject are those of Drs. Victor C. Vaughn, Kedzie and George McCracken.

Dr. Vaughn in the first of his experiments (physician and surgeon, Ann Arbor, Michigan, August, 1883), used a musk-rat, injecting into the mouth and rectum by means of a syringe fifty (50) grains of arsenious acid suspended in cold water. The rat was buried twenty-five (25) days, and the organs subjected to a chemical analysis, which revealed the presence of this poison in the kidneys, liver, lungs, stomach and contents, large intestine, small intestine, heart and brain. In his second experiment a cadaver was used, an unweighed quantity of arsenious oxide was introduced into the mouth and rectum, the body being then placed in a cellar for twenty-five (25) days. The brain was broken down, and in a semi-fluid condition, the rest of the organs firm. Chemical analysis revealed the poison in the right and left kidney, liver, lower lobe of right lung, heart, rectum, spleen, stomach and brain.

Dr. Kedzie, of the Michigan Agricultural College, working independently, made experiments on a cat with like results. In again

referring to the results of the experiments by the writer, it will be seen that arsenic was recovered from the *brain* of the animal into which this poison had been introduced. The fact that a poison, introduced after death, can penetrate through the various tissues and saturate the great nerve centers, protected and surrounded as they are by a bony casing, must be looked upon as an astonishing as well as an interesting fact. Upon this point Dr. Reese (Transactions of College of Physicians and Surgeons, 1877), observes: "It is scarcely conceivable that a poison introduced into a body after death could penetrate by imbibition within the cavity of the cranium and spinal cord."

In the experiments of Dr. Vaughn, the following explanation is offered for having found arsenic in the brain, viz., "In injecting the solution into the mouth, the syringe used clogged up, and on attempting to force it free, a portion of the fluid was observed to flow from the nostrils, some of this fluid probably adhered to the pharynx."

In the writer's experiments, when the dog employed was being placed in the box, a small amount of fluid was observed to trickle from the nostrils. Whether the presence of arsenic in the brain was due to the foregoing accident or not is uncertain. In a series of experiments on "Post-Mortem Imbibition of Poisons," Dr. Geo. McCracken introduced the three poisons, viz., arsenic, tartar emetic and corrosive sublimate, and subsequently recovered them by chemical analysis from several organs.

Though always allowable, it is not our purpose to attempt to draw positive deductions from the facts adduced, but rather to allow our own results, which have been gained by a strictly scientific process, *to speak for themselves.* In conclusion, however, it may be remarked that the hypothesis that arsenic through the process of post-mortem imbibition from the alimentary canal is, by careful chemical analysis, discoverable in the brain, *receives* entire confirmation from the present researches.

ASCENT OF THE VOLCANO OF POPOCATEPETL.

BY A. S. PACKARD.

THIS famous volcano, called Popocatepetl from the Aztec *popoca*, smoking, and *tepetl*, mountain, was the objective point of my journey to the Mexican plateau. The Nevada de Toluca I had seen a few days previous from the town of Toluca, on the Mexican National Railway. This volcano, however, is not a simple conical peak, but its snow-covered dome rises 15,156 feet above the sea, and out of a mountain mass with four lesser elevations about it. From Toluca the crater is seen to be a very large one, and we were told that it is 1500 feet deep with a lake at the bottom said to be two and a half miles across.

Orizaba we were yet to see; but nothing could, we thought, exceed in interest the distant view of Popocatepetl from the top of our hotel in the City of Mexico, as the setting sun gilded its snowy dome, and as it went down painted its snow fields with roseate hues. It is the grandest mountain summit of the valley of Anahuac. It repeats, but with emphasis, the purity of form and massiveness of Mt. Shasta, in Northern California. Its twin sister, the volcano of Iztacihuatl, or the "snowy woman," forms a part of the same isolated range—the Cordillera of Ahualco—and was doubtless thrown up at the same time; but it has no central dome cleaving the sky, the mountain mass extending as a range running nearly north and south, with three broken irregular snow-covered summits, of which the central is the highest, reaching an altitude of 4786 meters or 15,705 feet above the sea. The height of Popocatepetl has been variously estimated. Humboldt placed it at 5400 meters, or 17,716 feet; Guyot gives its altitude as 17,784 feet; Humboldt's measurement combined with those of two later observers, is 17,853 feet, while the French savans of the Maximilian expedition put it as high as 18,362 feet. The height of the City of Mexico above the sea is 7482 feet, so that we had before us an ascent of a little over 10,000 feet. This is nearly 2000 feet less of an ascent than that of Mt. Shasta, which is 14,442 feet high, while the plain out of which the California volcano rises is about 2000 feet above the sea.

For two days previous to starting we were occupied in arranging for the ascent. Our party consisted of three. Mr. F. A. Ober, author of the interesting Travels in Mexico, who had pre-

viously made the ascent, kindly accompanied us to the snow line as guide, interpreter and friend.[1] We laid in supplies of boiled chicken, other meats, bread and tea for our night at the ranch and the noon lunch on the summit. By the kindness of Messrs. D. S. Spaulding & Co., I obtained a letter from General Gaspar Sanchez Ochoa, the proprietor of the mountain, to one of his employés, Sr. D. Mariano Mendizabal, at Amecameca, who was ordered to send his son Rafael to guide us to the summit. The day previous to leaving the City of Mexico I telegraphed to Senior Norriega, a grocer at Amecameca, for horses and guides for a party of four. That evening the sun sat clear on Popocatepetl, and the weather promised to be clear and fine on the morrow.

On the morning of March 19th, after an early breakfast, we drove to the railroad station at San Lazaro, leaving it at 8 A. M. The sky was a little overcast, but soon the sun came out clear and hot. We soon crossed the edge of Lake Tescuco over a causeway, along the canals traversed by Indian dugouts, over the shallow reedy lake, in which were men and boys naked or stripped to the knees, wading through the water, fishing in its shallow depths with nets for shiners or axolotls. The track then leaves the lake and its flaggy, reedy shores and passes over a broad dry plain, the ancient bottom of Tescuco, the western portions of which are said, by Humboldt, to have been covered with water in 1521. Here were to be seen the mounds of that busy ant, *Pogonomyrmex occidentalis*, so familiar a sight from Montana to New Mexico and from Kansas to Reno, Nevada.

At the first station of Equipajes we get a fine view of Popocatepetl and Iztacihuatl. The railroad then skirts the borders of Lake Chalco, and we see upon our right many of the famous floating islands covered with green flags and reeds, which had survived since the time of Cortez. At the station of Ayotla the Indians crowd about the train offering fishes wrapped in the leaves of the pond lily, and here we bought half a dozen large axolotls for a cent apiece. We then passed within sight of Chalco, the oldest Indian town of the valley of Anahuac. Amecameca, the town where we take our guides and horses, is about forty miles by rail from Mexico and 1274 toises or 8223 feet above the sea. It is the highest town in Mexico; its elevation renders

[1] The two others were Professor J. W. P. Jenks, of Brown University, and Hon. Titus Sheard.

it more salubrious and cooler than Mexico, being nearly 600 feet higher than that city, and it is somewhat frequented by invalids from the city in hot weather. Before reaching the town, however, we pass through foothills covered with a growth of pines and oaks, with an intermixture of maguey or century plants under cultivation. The scenery now becomes very grand as we skirt along the ranges—from four to six—which are parallel with Iztacihuatl. At 10 A. M. both volcanic peaks were enveloped in cumulus clouds, but they rolled away from the mountain of the "white woman," still, however, obscuring the snow-clad dome of Popocatepetl. The massive base of Iztacihuatl below the clouds was seen to be studded with conical peaks, any one of which would be a prize in Maine or New Hampshire. As the train stops at Amecameca we pass the hill of Sacramonte, covered with a dense growth of noble cedars and pines surrounding the chapel on the summit, and enter the railroad hotel at eleven o'clock for dinner, first, however, regaling ourselves with the full and superb view of Popocatepetl and its sister volcano, whose serene heights now clear and well-nigh cloudless, looked down upon the town spread out over the valley at their feet.

After dinner we met our guide Rafael with his men, horses and pack mules at the grocery store of Señor Francisco Norriega, where we laid in additional provisions, and punctually at one o'clock started for our camp at the base of the peak. Our party consisted in all of seven horsemen, with two pack mules and three mozos or *guias* on foot. A *guia* is an assistant guide, usually an Indian servant or *mozo.* For the benefit of any one intending to make the ascent, I give in a foot-note[1] the particulars of our outfit of guides, servants, etc., with the prices, being a copy of the items in Rafael's bill.

[1] 4 horses at $2.00 a day	$16 00
3 guias at $2.00	12 00
2 mules at $1.50	6 00
1 barley for the horses and mules	1 75
6 pieces of leather for making sandals	1 31
8 straw mats	1 50
8 leather thongs	50
8 yards of cloth for wrapping the feet	1 75
Thread, etc.	25
A mozo to look after the horses at $3.00 a day	6 00
Rafael Mendizabal	10 00
	$57 06

We were urged to discard our shoes and let the guias wrap our stockinged feet in rags with a pair of rough leather sandals, but we preferred to wear over woolen stockings our ordinary high shoes and over the latter a pair of arctics, and found that they answered the purpose admirably in walking over the soft snow and yielding sand of the peak, while our feet did not suffer from the piercing cold winds of the early morning hours. We had provided ourselves at Mexico with a pair of native blankets for the bivouac at the ranch. Thick gloves are also needed, while blue-glass goggles, which most of the party bought at Norriega's, are absolutely indispensable. It is impossible to walk over the snow fields of Popocatepetl in the glaring sunshine without them. I carried and tried to use a pair of colored eye-glasses, but they would slip off while walking, and proved a source of constant annoyance until my *guia* changed with me, and considerately made the best use he could of my glasses.

The charges of the guide Rafael were fair, but we could have dispensed with the Spanish assistant guide and the mozo to attend the horses. The *guias*, or sub-guides, were Indians, nearly or quite full-blooded, and were strong, faithful young men. They expected and received besides their regular pay a gratuity for their services. Were I to make the ascent again alone, a good *mozo* besides the guide would be indispensable. No one should attempt to ascend the mountain alone without such attendance, as some accident might happen on account of the altitude, though there is no dangerous climbing. We were gone a day and a half from Amecameca, but of course two working days were spent and charged in our bill.

Our cavalcade passed through the dusty hot streets of the town, here and there shaded by hedges of cactus or maguey and rows of mesquite trees, the unclouded tropical sun beating upon our heads, though a cool westerly breeze somewhat refreshed us. Leaving the town the road passed through broad wheat and corn fields, and in an hour's ride from the city we left the plain and came to the edge of the foothills of the cordillera of Ahualco, the range from which rises the two volcanoes, of which Popocatepetl is the southernmost.

We were now ascending, and were for several hours to ascend the range, into the pass between the two volcanoes over the trail made by Cortez during his march from Puebla to the City of

Mexico. We met trains of pack mules and donkeys coming from Puebla, and it added no little zest to our ride to recall the memorable march of the Spanish conquistador from the plains of Puebla to the then famous Aztec capital of Tenochtitlan.

In his Essai politique sur le Royaume de la Nouvelle-Espagne, Humboldt refers to this road or trail, which was first opened by the ancient Aztec couriers from Mexico to Puebla by way of Amecameca.[1]

The plains over which we trotted were evidently an old lake bottom. The road now ascended between low rounded hills which had every appearance of moraines; they were composed of loose sand and gravel, with boulders of black basalt like that forming the volcano, and sloped gradually down to the plain. One very regular mound which we passed on our right, which rose abruptly from a corn or wheat field, seemed to have been artificial in its origin. It is Tetepetongo, "the hill of the round stones," and according to tradition, says Ober, was formerly used as a place of sacrifice. But the zone of moraine-like hills we were now passing over contrasted strikingly with the broad flat plains beneath us and with the ragged volcanic foothills of Iztacihuatal far above us on our left. Though this peak was capped with clouds, the larger part of the snowy dome of Popocatepetl was in full view, and from it two glacier-like streaks of snow led down the valleys, losing themselves in the ragged lava streams at the base of the cone. As we pass onward and upward conical tumuli of loose débris from the mountains above confront us, and well-marked lateral moraines extend out upon the plain on each side of the trail. We should judge that the level at which we saw the lowest moraines was about 9000 feet above the sea; from that level they were observed up to or near the snow line, the height of which above the sea, in the latitude of the City of Mexico, Humboldt puts at 4600 meters or 15,333 feet. We were unable to see such good clear natural sections of a

[1] Lorsqu'au mois d'octobre de le l'année 1519, le corps d'armée des Espagnols et des Tlascaltèques marchoit de Cholula à Tenochtitlan, il traversa la Cordillère d'Ahualco, qui réunit la Sierra Nevada ou Iztacihuatl à la cime volcanique du Popocatepetl. Les Espagnols suivirent à peu près le même chemin que prend le courier de Mexico pour aller à la Puebla par Mecameca, et qui se trouve tracé sur la carte de la vallée de Tenochtitlan. L'armée couffrit à la fois au froid et de l'extreme imptéuositée des vents qui règnent constamment sur ce plateau.—Essai politique, etc., II, 672.

moraine as would have been desirable, but in one instance the moraine was composed of the fine mud scrapings of the lava with rounded boulders of basalt of all sizes up to four or five feet in diameter, the hill being covered with wheat and small corn. Moreover the hills above the moraines on each side of the valley had apparently been molded by ice. I infer from all I saw on the ascent that the ice must have filled the valley or pass between Iztacihuatl and Popocatepetl, spreading out over the plateau like a *mer-de-glace* and sending glaciers down to the lakes then covering the plains of Anahuac. Above the rounded hills were rough volcanic spurs and hills which may once have overlooked the ice streams.

It would appear, then, that the Quaternary lakes of the Mexican plateau (unmistakable evidences of which I saw throughout the country from Laredo to San Luis Potosi, and thence to the City of Mexico, as well as along the Mexican central route to New Mexico) were fed by the melting of glacial ice in the high sierras. At any rate in the valley of Anahuac the volcanoes rising above it must have been covered with glaciers which descended to a point 9000 feet above the sea, and about 1000 feet above the present level of the plains.[1]

The change in vegetation as we left the plains and wound among the moraines was an interesting feature of the ride. The zone of cactus, nopal, mesquite, etc., of the Mexican plateau was replaced by a belt of pines, aromatic firs and cedars; the flowers had changed in character and become more numerous and varied than on the dry and dusty plains; lupines predominated, relieved by a showy red labiate flower and yellow-flowered shrubs. Of

[1] In conversation with Mr. Otto Finck, to whom I described the moraines about Popocatepetl, he told me that what he regarded as true glacial moraines extended down along the route of the Mexican railway as far as Peñuella, which is three miles east of Cordova, and is 2500 feet above the sea, Cordova being 2700 feet elevation. I had seen boulders of porphyry above the city of Orizaba, and Mr. Finck, who is an observer of long experience in the State of Vera Cruz, having explored the country for hundreds of miles on foot, and being a naturalist of experience, kindly took me down to the bed of the river, where were boulders of different kinds of porphyry, evidently derived from the plateau above and westward. On the plains of Jaumatlan and Chocaman, he told me, are boulders of porphyry, weighing 200 tons, and also glacial scratches. Mr. Finck drew for me a section of what he regarded as a moraine observed at the Pass of Metlac, in which were angular blocks of porphyry of ten or twelve kinds, with gneiss, which must have been transported from the plateau above. Below an elevation of 2500 feet Mr. Finck had not in the State of Vera Cruz, or elsewhere in Mexico, observed any glacial marks.

deciduous trees, willows abounded, but few if any oaks. Through these forests, not very dense or continuous, pumas and wolves were said to roam. The insect life of the plains is scanty in the dry season, but in this zone bees and butterflies of different species visited the flowers. The zone of pines and willows was succeeded by a belt of tall coniferous trees like a spruce with a fir-like habit; their slender shafts two to three feet in diameter (in one case of a tree felled with the ax, five feet) pierced the clear sky over perhaps 125 feet. This noble tree had very broad leaves and a deep red bark, like the red woods around the base of Mt. Shasta. This zone of red wood was succeeded by a belt of low short-leaved pines which grew shorter and more stunted until at half-past four we came to banks of snow lying on the summit of the grassy pass, the remnants of larger fields which had but lately disappeared. The air was now cool and even chilly, the ground was damp and often wet; here it was early spring, like our first of April in New England, too early for flowers; scattered plants, perhaps Alpine but quite unlike any we have seen in the Rocky mountains, were not yet in flower, and to add to the resemblance to a northern spring a flock of veritable robins flew among the pines; they were lingering on the flanks of Popocatepetl before taking their final flight northward.

The path to the ranch now left the Puebla trail and led us among the pines to the sheds where we were to spend the night. The rancho was reached at 5.40, and an hour still remaining before dark, I walked to a ravine over piles of volcanic ash and lapilli to entomologize under fallen pine logs and the bark of stumps, finding lizards, beetles, spiders and myriopods quite unlike any forms yet seen in the *tierra templada* below, but with no trace of Alpine characters.

The ranch was a deserted shed and furnace-house for roasting the crude sulphur formerly collected by the *volcaneros* or peons at the bottom of the crater.

Darkness gathered early about the ranch, but in the bright moonlight the massive, marble-like dome of Popocatepetl rose directly above us. Our horses and mules were left to stand in the open air while we bivouacked in the shed, in the center of which was a raised circular fireplace on which our guias made a fire of sticks and logs, the smoke and sparks passing up through a hole left in the middle of the roof. The Indians boiled their

coffee in their glazed earthen jars, which in the long run withstand the heat of the fire better than a tin coffee-pot; they made tea for the party in other vessels of domestic manufacture; they refreshed themselves on cold tortillas and chili, the twin components of a Mexican meal, and then cut out their sandals for the morning's climb, while we dismembered a cold broiled fowl of pronounced toughness and ate it with excellent native bread and tea. To the tourists and head-guides was assigned a sort of low raised divan or floor covered with hay, over which we spread the straw *petates* or pallets, and finally a blanket, with a second blanket and a coat over us. The *guias* and muleteer lay on the mud floor, their feet to the fire; their swarthy faces and limbs not visible in the gloom, their white cotton garments concealed by their high-colored serapes or blankets. They slept soundly through the night, but not the tourists; the beds were uneven, an occasional flea danced a jig on our hands and faces, a rain and hail storm with a strong gale of wind rattled about the ranch; towards morning it grew very cold and chilly; added to this two of our number, owing probably to the altitude, were unfortunately seized with vomiting and diarrhœa, so that there was little or no sleep for the Americanos that night.

At 3.40 A. M. of the 20th I awoke the party, the *guias* replenished the fire, prepared the coffee and tea, saddled the uneasy horses now shivering in the cold frosty morning air, and at 5.30 we had mounted our steeds and were under way for the peak. It was a bright, crisp, clear, cold morning, the stars still shining brightly, while a piercing cold wind swept down the valley over the pass. Our guides had wrapped their legs in thick layers of cotton rags, wound their *serapes* tightly about them, and we found that our overcoats and gloves were but a slight protection against the intense cold. For two hours we slowly crept up by a zigzag trail, urging on our unwilling nags over the slope of the mountain; first passing through the pine woods, then descending a barranca or ravine, through which ran a stream fed by the snows of the peak. The trail then wound along the base of the cone over fields of loose, deep, coarse, black, volcanic sand, through which rose scattered jagged masses of black lava. Our faltering horses and not over enthusiastic guides toiled upward and onward, until at 7.30 we reached La Cruz, a rock on which was a woode- cross, where we were to leave our horses

and begin the ascent on foot. Here, owing to sickness induced by the altitude, my companions were obliged to return to the ranch. Taking Rafael and two *guias* I went on.

The ascent of Popocatepetl is prosaic in the extreme. Much to my surprise there were no rocks to clamber over, no difficult climbing, but an interminable steeply inclined desert of deep, coarse, yielding, volcanic sand, covered with a thin sheet of snow —névé—making it exceedingly hard walking, to say nothing of the effect of the great altitude upon the heart. The height of the lower level of the snow-line Humboldt estimated at 15,300 feet.

The cone of Popocatepetl is like that of Vesuvius—only more so. We roughly estimated the angle of the slope at 30°, but judging by our feelings after two or three hours' climb, it seemed like 75°.

There is no definite trail up the mountain, and at no point on the route can the summit or mouth of the crater be seen, so that there is no goal in sight to draw one's attention away from the labor and fatigue of the ascent. Looking up hopelessly from time to time as we stop to get breath, anxiously trusting to obtain a glimpse of a rocky peak breaking through the crust, nothing meets the eye but a vast snowy slope melting away far aloft in the sky, the unsullied surface like polished marble of more than parian purity, fading gradually away to be replaced by the deep, fathomless azure of a Mexican sky.

By eight o'clock the sun had gained more power, the exercise warmed us, so that we no longer suffered with the cold, but the effect of the intense sunlight upon the eyes was blinding and painful; it would have been well-nigh impossible to have made the ascent without blue goggles.

Our small procession moved in the following order: my own particular *guia*, a young, stout, willing Indian picked out a way over the rough snow or sand, as the case might be, the writer followed, planting his feet in the prints made by the Indian, and supporting himself with a rude, improvised alpenstock, usually held in both hands; behind followed the supernumerary *guia*, carrying the lunch basket on his back, while Rafael brought up the rear, with the air of one fulfilling a contract rather than enjoying the ascent. And it was hard work. I have ascended Pike's peak three times, walked up Gray's peak twice, have climbed the crater of Mt. Shasta, which is over 12,000 feet high, ascended

Vesuvius and Snowdon, and not a few peaks in the White mountains, the Adirondacks and Northern Maine, but the labor of the ascent of Popocatepetl, owing to the far greater altitude and the consequent rarity of the atmosphere, as well as the yielding sand and the nature of the snow is peculiarly difficult.

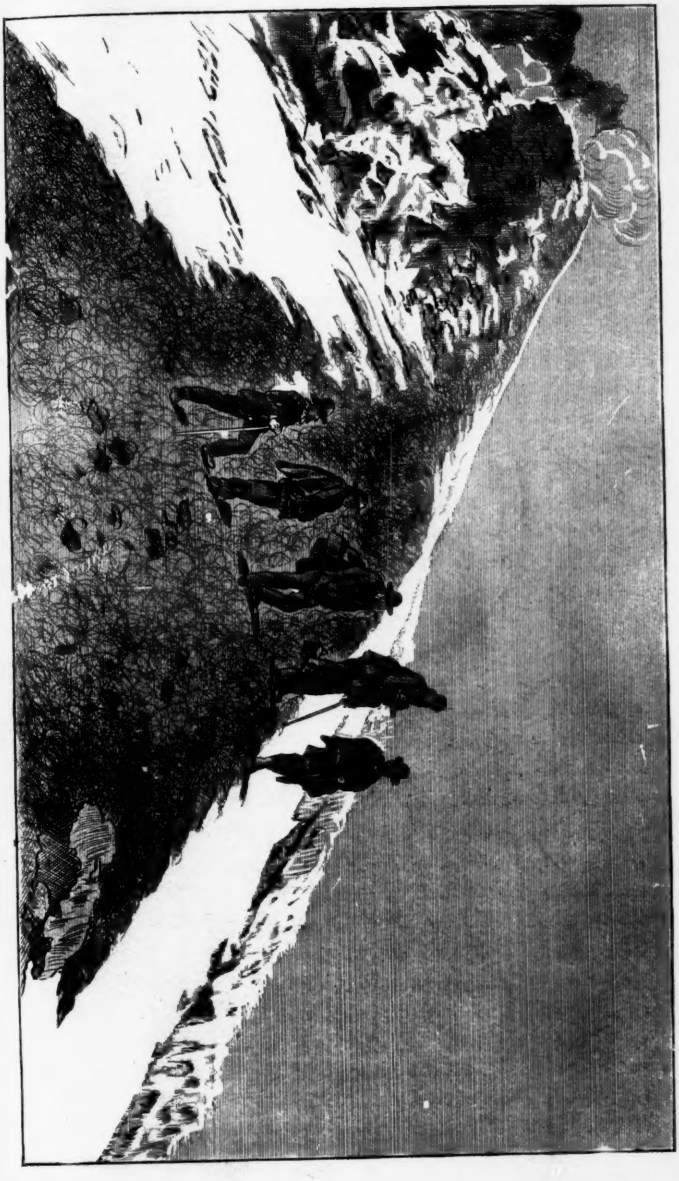
To my surprise the snow lay on Popocatepetl as a thin sheet of from a foot or two to six or eight feet thick—deeper of course in the ravines, but the ravines were of a mild type. The ascent is made from the northerly and westerly side; the deepest ravine was filled with snow passing beneath into ice, thus forming an incipient glacier perhaps nearly a mile in length. Looking at it the day previous, from the road below, I supposed it to be a true glacier filling the ravine, but it can scarcely be regarded as such, whatever may have been its dimensions in early times.

The surface of the snow fields over which we walked was exceeding rough. The snow was, on the average, about three feet deep, cut up by deep narrow fissures lying at various angles to our line of march; the footing was thus very rough and uncertain; the snow grew softer as the sun rose higher, and it was impossible at times to prevent slipping and falling down. Four hours of such work to one not hardened to mountain climbing at such an altitude, reaching nearly or quite 18,000 feet, are no child's play. One advances three or four steps, and thoroughly exhausted sinks down upon his staff to rest and recover his breath; his heart beats in a wild extravagant fashion, and his breathing is short, quick and labored. No one should attempt the ascent who has not a healthy heart and sound lungs, and is not under fifty. There is danger of over-fatigue.

At about half-past ten the summit seeming no nearer than at the start from La Cruz, I asked Rafael how long it would take to reach the top. He, thinking I might give it up, craftily replied, "*dos horas;*" not satisfied with this I privately asked my trusty guide in front, and he said, "*una hora.*"

Just then a whiff of sulphur vapor passed by, the draught though nauseous was inspiring, and gave new strength to my tired limbs, and at eleven o'clock I suddenly walked over the edge of the crater and could look part way down into the bowels of Popocatepetl. We were on the summit, could walk on level ground along the narrow sandy edge of the crater, without fatigue, the heart at once resumed its normal beat and the respiration became again natural.

PLATE VI.



Summit of Popocatepetl, just within the north-west edge of the crater.

The transition was thrilling. Here we were on the summit of the highest mountain between Mt. St. Elias in Alaska, and Chimborazo in Peru! The sky was well-nigh cloudless, a few cottony masses hung over Iztacihuatl to the north of us, partly obscuring its peaks; the plains of Anahuac and the Puebla valley bathed in the sunlight, and wrapped in a warm, soft haze, stretched for hundreds of miles away west and east; the volcano of Malinche to the north-east seemed like a pigmy cone; the city of Puebla could be distinguished, but Cholula and its pyramid, which lay nearer, were lost in the haze; we could not detect the city of Mexico and its adjoining lakes, nor could I make out the volcano of Orizaba, which lay to the eastward 150 miles.

But our interest centered in the crater. In comparison with that of Vesuvius or Mt. Shasta it was, it must be confessed, tame. Many have looked down into the crater of Vesuvius; that of Mt. Shasta is a funnel-shaped chasm over a thousand feet in depth, the snow fields extending from the rim to the bottom, in which lies a frozen lake. The view into it was memorable.

Descending a few feet to a rock overhanging the chasm now before us, we could take in the entire basin. It seemed to us to be about 500 feet deep and from 1000 to 1500 feet across at the mouth, but according to Gen. Ochoa's measurements it is a thousand feet deep, and the floor is 200 meters in circumference. It is not an irregular chasm like that of Vesuvius, but like a vast cauldron in shape, the steep sides visible all around, and the bottom broad and somewhat flat, with no large, deep fissures visible. Gen. Ochoa told Mr. Ober that there are more than sixty solfataras or smoking vents in the crater, one of them over fifty feet in circumference; he called the vents *respiradores*.

The northerly rim is of loose volcanic sand which has been blown up out of the crater. Perhaps two-thirds of the rim was of solid lava more or less jagged and irregular, the highest portion on the south-east side. Looking across from the northerly side one is confronted by three well-marked layers of vertically columnar basalt marking three successive overflows, while a less regular fourth layer indicated an additional eruption. The rock composing the sides of the crater, the mountain itself and the sand lying on its flanks is a tough, black basalt, slightly porphyritic.

Near the rim of the crater on the west side is a sulphur fuma-

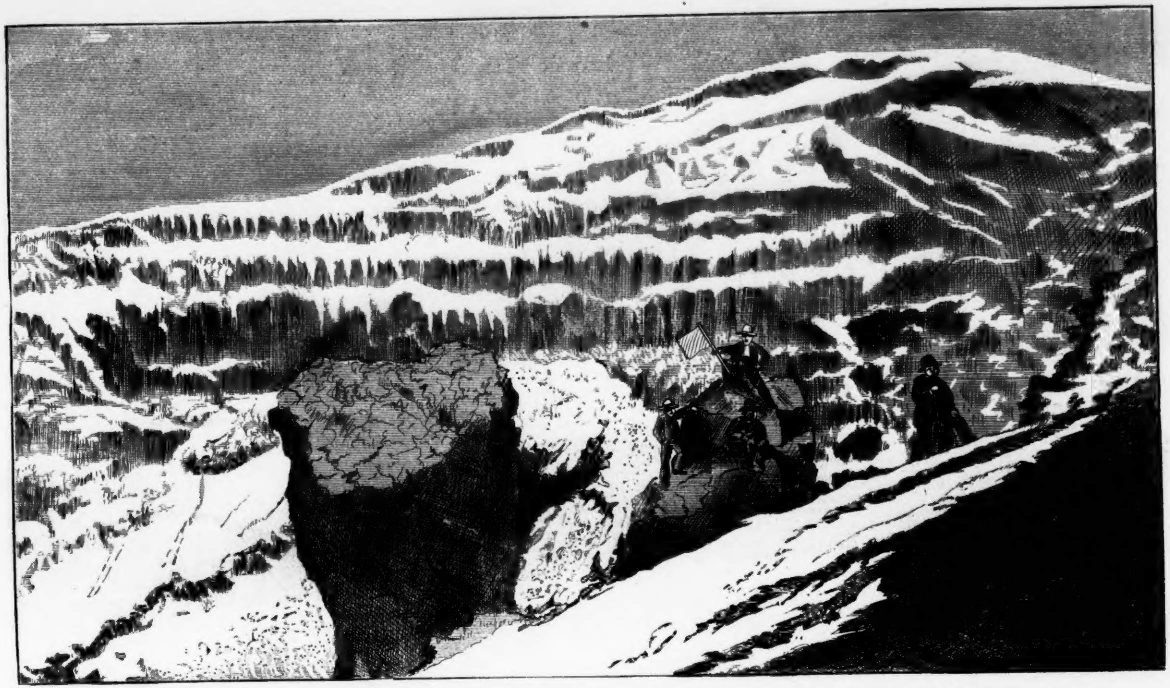
role or *respirador*, a fissure from which issued clouds of sulphur fumes. At the bottom of the crater were plainly seen two large sulphur vents or solfataras, with smaller ones from which clouds of vapor rose perhaps to a height of over a hundred feet, but certainly not half way up to the edge or top of the peak. Whether these fumes can be seen from below, at the base of the mountain, is a question. Some still claim that the mountain smokes, and that the smoke can be seen from below, but this is doubted. The assertion was made in the time of Cortez. Humboldt says: "Ce volcan, que j'ai mesuré le premier, est constamment enflammé; mais depuis plusiers siècles ou ne voit sortir de son cratère que de la fumée et des cendres."[1] It is not impossible that the slight amount of sulphurous vapor which is emitted from the crater may at times increase and be visible at night by moonlight from the plains below, or even in the daytime during certain states of the atmosphere. I well remember that in May, 1872, a month after the great eruption of Vesuvius, no smoke was seen to rise from the crater by day, but by moonlight, at Naples, I could detect a slight column of vapor hanging over the summit of the cone.

The sulphur vents were surrounded with masses of bright yellow sulphur. Near where we stood were two or three stumps of posts which had been driven into the volcanic sand and gravel to support a windlass or winch, by which the *volcaneros* were let down into the bottom of the crater to gather the sulphur there. It was borne in sacks on the backs of Indians down to the ranch or sheds where we spent the night, and there sublimed in earthen pots. The crater was not measured until 1856, when General Ochoa estimated its depth and circumference. We roughly guessed that its depth was about 500 feet, but distances, looking down into a mountain, are very deceptive. It appears that in the time of Cortez a Spaniard descended the crater, tied to a rope, to the depth of from seventy to eighty fathoms or 420 to 480 feet.[2]

[1] Essai politique sur le Royaume de la Nouvelle-Espagne, Tom. II, p. 238.

[2] "Ou voit, par la troisième et la quatrième lettres de Cortez à l'empereur, que ce général après la prise de Mexico, fit faire d'autres tentatives pour reconnoitre la cime du volcan, qui paroissoit fixer d'autant plus son attention, que les indigènes lui assuroient qu'il *n'étoit permis aucune mortel de s'approcher de ce site des mauvais esprits.* Après deux essais infructeux, les Espagnols réussirent enfin, l'année 1522, à voir le cratère du Popocatepetl; il leur parut avoir trois quarts de lieue de circonférence, et ils trouvèrent sur les bords du précipice un peu de soufre qui avoit été

PLATE VII.



Within the edge of the crater, looking across to the lava beds on S. E. side, forming the highest point of the summit.

An hour was spent on the inside of the edge of the crater, where we ate our lunch. The air was delightfully clear and cool. We were wonderfully fortunate in having so clear and bright a day, as the peak is usually covered with clouds by ten o'clock, and for this reason we were advised to start from the ranch by daybreak. The summit is of small extent, the edge of the crater is quite free from snow, but a few feet down on the outside from the edge on the north side, the snow begins as a perpendicular wall, three or four feet deep, like a petrified crest of a wave, as if the snow had been melted by the breath of the crater. The following week on visiting Puebla, which lies due east of the mountain, we observed that there was no snow on the eastern and southern sides of the volcano, the snow fields on the northern side being preserved from melting by their more shaded situation. Without doubt the snow fields of Iztacihuatl, which extend along the western side of the range, are also thin, and give rise to no extensive glaciers.

Whether there has been an eruption of Popocatepetl in historic times is a matter of doubt. It is possible that showers of ashes may have been blown out of the crater, but certainly there is no recent stream of lava or obsidian on the mountain slopes. Humboldt, however, quotes from a letter of Cortez stating that much smoke rose from the crater, and that clouds of ashes enveloped two men who ascended part way up the mountain.[1] From this it would seem that the volcano was rather more active three and a half centuries ago than at present, but it is to be doubted whether there has been an actual eruption of lava within a thousand years. According to various authors there were eruptions in 1519, 1539 and 1540.

déposé par les vapeurs. En parlant de l'étain de Tasco dont ou se servit pour fondre les premiers canons, Cortez rapporte, 'qu'il ne manque point de soufre pour fabriquer de la poudre, parce qu'un Espagnol en a tiré d'une montagne, de laquelle sort perpétuellement de la fumée, en descendant, lié à une corde, à la profondeur de 70 à 80 brasses.' Il ajoute que cette manière de se procurer du soufre est tres dangereuse, et que par cette raison il sera plus prudent de la faire venir de Serville" (Essai politique, etc., II, 673). The depth of eighty brasses or fathoms would be 480 feet.

[1] However Cortez expressly says, "That their men ascended very high, that they saw much smoke go out, but that none of them could reach the summit of the volcano, because of the enormous quantity of snow which covered it, the intensity of the cold and the clouds of cinders which enveloped the travelers" (Essai politique, etc., II, 672).

Here in passing I may remark that Orizaba is now said to be slightly higher than Popocatepetl, though Humboldt claimed that the latter was 600 meters higher than any other mountain from Mt. St. Elias to the Isthmus of Panama. Mr. A. H. Keene, in the Encyclopedia Britannica, gives the height as 17,176 feet. I obtained excellent views of this noble volcano at different points along the Mexican railway to Cordova. Seen from the west the snow fields stretched in glacier-like streaks down its slopes; at the station of Esperanza, however, the clouds parted so that the summit could be seen from the south, and it was observed that the dark streaks of sand or rock extended in broken patches to the very summit. Orizaba rather disappointed me from this point; it is far less imposing and majestic a peak than Popocatepetl; it is not so isolated, its great height being apparently lessened by the high mountains of the Sierra Nigra extending from it towards the railroad. Moreover its summit is broken up into subordinate peaks. Farther on near where the railroad descends into the great *barranca* or ravine west of the town of Orizaba, the volcano of that name is seen to be of solid lava, furrowed by deep ravines; while Popocatepetl is more like a vast conical heap of ashes. Never, however, shall I forget the magnificent view of Orizaba which I had from under the coffee trees and bananas of Cordova. It was eleven o'clock in the morning, the clouds had lifted and rolled away from the mountain, which rose in a magnificent conical mass far above its humbler fellows of the Sierra Nigra. From the illustrations given by Humboldt I imagine that the finest view of this imposing peak is from the forest of Xalapa, to the north-east. This volcano is said to have been quiet since 1566.[1]

[1] Mr. Hugo Finck of Cordova, who has explored the base of Orizaba, told me that the crater is one and a-half miles long and a half mile wide, but that it cannot be entered. He saw Orizaba smoking, probably the gases from the solfataras, and stated that the mountain had erupted near the base, where there are small craters. He has seen a glacier near the summit, and thinks there are others; they slide down and melt away, the summit above being bare, with no *mer-de-glace.*

It seems probable that there are at the base of Orizaba Archæan rocks, as Mr. Finck told me that gneiss occurs as far up the sides of the mountain as 13,000–14,000 feet, while higher up the mountain is composed of a grayish porphyry. In the center of the Sierra Nigra and the mountains southward between Esperanza and Orizaba, are Silurian, Devonian, and Carboniferous strata with a fœtid black limestone, succeeded by bluish Jurassic limestones containing fossil fishes, oysters, belemnites and ferns. In the Cretaceous hills three miles east of Cordova fine ammonites occur. It seems probable from what Mr. Finck told me, and my own hasty observations from Mexico to Cordova, that all these principal formations occur from the center of the Mexican plateau to the seacoast at Vera Cruz, the plains of the latter State being of Tertiary and Quaternary age.

But we must reach Amecameca by dark, as in traveling through the woods after twilight we might fall in with objectionable company.

At twelve o'clock we began the descent, and it reminded me strongly of the twenty minutes' descent or run down Vesuvius. After zigzagging down over the snow and ice, now quite yielding, stopping frequently to rest one's tired knee-joints, on reaching the sand below the snow fields, my two guias each took one of my arms and we ran down the long sandy slope arm-in-arm. We reached La Cruz by about two o'clock, and walking on a mile or so more down the slope, I found a horse which Mr. Ober had sent me, in waiting. Reaching the ranch at about three, after half an hour's rest and refreshment, Mr. Ober and myself rode with our guide Rafael fifteen miles to Amecameca, while our *guias* trotted the whole distance on foot behind their pack mules.

Nothing is more monotonous in its flatness than a Mexican bedstead, while the mattress is only thicker than a Mexican blanket, the bed being but a little more yielding than the soft side of a pine board, but that night—spent in a second-class Mexican hostelry, after such a long day's work with the alpenstock and in the saddle, half frozen in the morning on the mountain side and half roasted in the hot mountain gorges and on the dusty plains in the afternoon,—that night was given without reservation to the worship of Morpheus. The next day at ten we reached the site of ancient Tenochtitlan, rested in the grand plaza under the shade of the orange and banana, by the plashing fountain, our eyes feasting on the varied, ever-changing pictures of Indian, Mestijo and Spanish types of Mexican life passing before us in that famous square.

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NOTES ON THE ŒCODOMAS, OR LEAF-CUTTING ANTS, OF TRINIDAD.

BY C. BRENT.

AN opportunity was afforded me during the winter of 1884–5 for studying the life and habits of this most interesting species on the Island of Trinidad, West Indies. Several species are here distinguished; all, however, are alike in form and habit, the variety being produced by variation in size and color. These insects are extremely numerous, indeed one cannot take a walk anywhere in the country without observing broad columns of

seemingly animated leaves marching across the roads. Complaints are heard on every hand of their ravages among the gardens and plantations. Agriculture is all but hopeless in sections infested by these pests, since although they occasionally attack one of the forest trees, they show a decided preference for the leaves of cultivated trees and garden plants, the cocoa, coffee and orange being particularly subject to their destructive visits. They seem also to develop a "penchant" for particular trees. One orange tree in a grove of the same species is stripped again and again, while the neighboring trees are left untouched. The curious habit these ants possess of cutting and carrying off immense quantities of leaves, has often been noted in books on natural history, although the question is still an open one as to the object of the custom and the disposal of the cut leaves. My own observations on these points I shall give farther on.

The speed with which these little workers operate is indeed marvelous. A good sized mango tree, at least as large as an average apple tree, I saw stripped of every leaf in one night, and greater feats than this are recorded of these "Tourmi Ciseaux," as they are called by the Creoles. In the morning the naked boughs bore only the bare midrib of the leaves with here and there jagged portions of the parenchyma left by the circular pieces snipped off. The ground was littered with circular pieces of leaves about the size of a ten-cent piece, which the ants had neglected to carry off. Old leaves and young had alike been snipped off, but most of the pieces left were cut from the older leaves.

During the day I discovered the formicarium to which these ants belonged, some three or four hundred yards up the mountain side. It was situated on a gently sloping incline covered by a dense "vastrajo," or second-growth wood. The site of the hill had been well chosen in a spot free from large trees, and the smaller bushes had been removed, leaving the soil as bare as if the vegetation had been destroyed by a fire. The mound was of immense size, being about forty-five feet across and about two feet high. The soil was of a different color from that of the surrounding hillside, and consisted, I found, of clayey granules brought up by the ants from the subsoil below. No signs of ants were visible, nor were any recently used entrances to be seen. Several tunnels extended a short distance into the mound, but

they were all *stopped* up by soil washed into them by the deluging rains that had been falling for several previous days. Cutting my way through the bushes by means of that useful and indispensable part of a forester's outfit for tropical woods, the "machete" or cutlass, I found, some twenty yards up the hillside, an entrance from which led, as far as the eye could see, a wide smooth path, worn by repeated travel some five inches deep, and carefully cleaned of all vegetation, dead leaves and rubbish. A few yards from the entrance a huge tree had fallen but recently across the pathway, but the industrious insects had dug a tunnel six inches in diameter under it in preference to climbing over it or making a new path around it. A little farther on I met another instance of formic ingenuity. The path led to the edge

FIG. 1.—An Œcodoma formicarium. The cleared space is forty-five feet in diameter.

of a ravine where it branched; one branch led directly across the ravine, down the precipitous sides of which an oblique path had been excavated at an angle of about 45°; the other branch led up the edge of the ravine some twenty yards to a fallen tree which spanned it. Over this the pathway led to the opposite bank, down which it ran to join the direct path below. I subsequently noted that during the rainy season when the ravine held a stream of water, the ants toiled up the hillside to their bridge, but as soon as the water dried up they used the nearer path directly across the ravine. On looking around the mound I found five other entrances to the formicarium, all at some distance from it, and from each of these diverged a pathway through the woods. Along one of these traveled a dense column of ants, those

outward bound keeping the right hand side, while those returning home traveled along the left. The incoming ants were nearly all laden with their leafy burdens which they carried tightly gripped between their mandibles, sometimes nearly upright, or thrown back so as to completely hide the insect below. This curious fashion of carrying the leaves has earned for them the common English name of "parasol" or "umbrella ants."

Along the path were several heaps of leaves, which were probably carried away by a fresh relay of workers; often these heaps may be noticed lying deserted along the pathways, but they are invariably removed, sooner or later, to the nest. The leaves

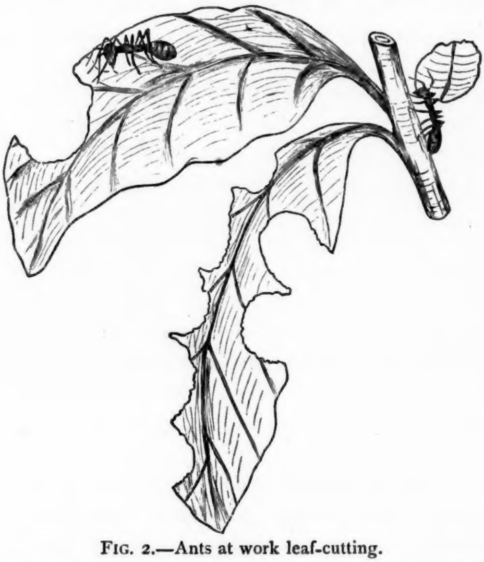

FIG. 2.—Ants at work leaf-cutting.

were those of the cocoa, so I traced the column down the hillside some four hundred yards to the edge of a cocoa plantation, where I found them actively engaged in leaf-cutting. The smaller trees were swarming with the little depredators, leaves were falling plentifully as the little sawyers snipped them out. Numbers of ants marched up the tree and numbers marched down, very deftly managing their awkward-looking burdens. Sometimes they progressed sidelong down the tree, sometimes backwards, according to the condition of the surface over which they walked.

In operating on a leaf the ant places herself upon the upper

surface near the edge, and saws a circular cut nearly all the way round with a saw-like motion of her finely serrate mandibles. To prevent the section falling she does not saw it all round, but when nearly severed seizes it by the edge and by a sharp upward jerk detaches it. Now she either marches directly off to the nest or lets the fragment drop to the ground and begins sawing another. Often quite a heap of pieces accumulates beneath the busy little sawyer.

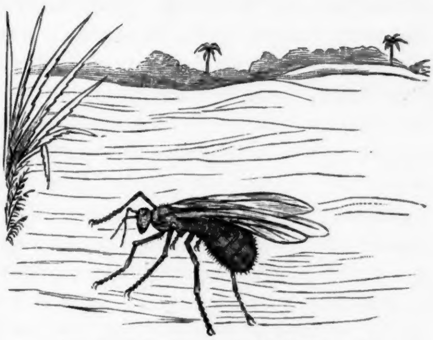

FIG. 3.—Œcodoma of Trinidad, male.

The Œcodomas are differentiated, as in other species, into males, females and workers, the latter being of course undeveloped females. Four classes may be distinguished among the workers, only two of which take part in the foraging expeditions. The majority of these workers are of a pale reddish color with a

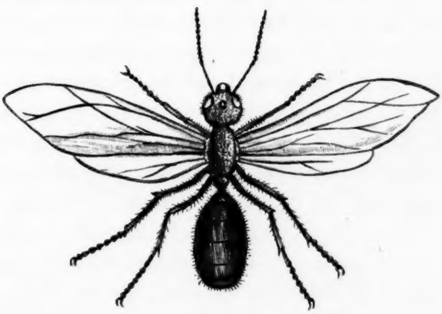

Fig. 4.

Fig. 5.

Fig. 6.

FIG. 4.—Female. FIG. 5.—Worker major, or so-called soldier. FIG. 6.—Worker minor. All natural size.

stout body, short round unpolished head, which carries behind a

pair of spines. The thorax is very sharply constricted in the middle, the fore part, or prothorax, carrying the first pair of legs and a pair of spines upon the dorsal surface. The hinder part, or meso-metathorax, carries the other pairs of legs and two pairs of spines. The cutting instruments are a pair of long extremely sharp-pointed mandibles finely serrated upon their inner surface, which may be used as saws or nippers. The workers vary extremely in size; individuals are met with only three-sixteenths of an inch in length, while others attain a length of nine-sixteenths. These smaller (younger) ants accompany their older sisters in their expeditions but rarely carry leaves. They may often be seen riding upon the burdens of their older and larger sisters as if tired. I have observed as many as three clinging to a leaf which was carried with apparent ease by one of the larger ants. A number of these little ants may be observed to issue from the mines with the old ones and loiter around the entrances as if as yet unable to take part with the stronger ants.

Here and there among the mass of workers, perhaps forming about one per cent of the total number, may be seen a much larger, formidable-looking ant with enormously swollen triangular head, which takes no part in the work, but always accompanies the "worker minors," as they are called, on their expeditions. I spent much time trying to find out the functions of these large-headed ants, but failed to get any clear notions as to the part they play in the politics of the commonwealth. They may nearly always be seen on a bit of stick or other eminence, caressing now and then the antennæ of the passing ants with their own. Talking, we may suppose, in ant language, since it is well established that ants are, by means of their antennæ, able to communicate their ideas one to another. It appears to me that these apparently useless ants directed in some way or other the movements of their working sisters. Bates in his Naturalist on the Amazons, came at first to the same conclusion, but afterwards abandoned this idea for one I think not more tenable, namely, that these ants by their superior size draw upon themselves the attacks of ant-eating birds, &c., being thus, as he terms it, merely "pieces de resistance," thus only serving to preserve the main body of workers by a self-sacrifice of mere "passive" resistance.

I went to the trouble to shoot several ant thrushes and Den-

drocolaptes which feed almost entirely upon ants, to see if there was any foundation for this theory, but found very few indeed of the so-called "worker majors," although the crops were distended with "worker minors." In other works on natural history they are termed "warriors," but they by no means correspond to the warrior or soldier class in the Termites, for instance. They have no special offensive or defensive weapons, their movements are more sluggish even than those of the smaller ants, and when the nest is disturbed by poking it with a stick, the smaller ants only prove pugnacious. In the battles which so often occur between the mail-clad bandits of Trinidad forests, the savage "Ecitons," or "hunting ants" and the "parasol ants," the brunt of the fight is borne by the "worker minors" who always drive off the marauding Ecitons.

In some Œcodomas there is a series of intermediate forms between the working minors and the working majors, and in some species all take part in leaf-cutting. Besides these workers there are two other classes, which never leave the mines, the worker nurses, to be distinguished from the working minors chiefly by their hairy heads, and another class of very large ants, individuals of which are found nearly an inch in length. This class is represented in each formicarium by only a few individuals, which are distinguished by their large hairy heads and the possession of a twin ocellus placed in the middle of the forehead. These never leave the mines, and are seen only when the formicarium is opened.

The ant hill referred to above being a pest to the neighboring plantations, it was determined to destroy it. Poisons were found useless. Corrosive sublimate and potassium cyanide were mixed with farina and deposited near the nest. These were simply ignored; the ants would not touch them after a few had fallen victims. A solution of arseniate of soda was next sprinkled upon orange leaves, which were strewed upon the mound. These were eventually cleared away, although at an immense sacrifice of life. This points, I think, to the true ant food, since unless the juices of the leaves as they were sawed up were swallowed, the poison would have had no effect. This idea is strengthened by the fact that fiery and strongly aromatic plants as well as those with poisonous, milky juices are carefully avoided. No solid food is found in the crops of the insect at any time, but if

these are examined after the insects have been engaged in leaf-cutting, they are found full of green leaf juice. Finally we destroyed the nest by drowning, the common method during the wet season. A number of channels were dug in the hillside, all constructed to collect the rainwater as it streamed down the hill, and to pour it into the nest by one of the entrances. I visited the nest during the next rain to see how the plan was working, and was surprised to find the water pouring out of an orifice twenty yards below the nest. After the rain I examined this tunnel and found that it entered the nest at the lowest point, some eight feet below the surface. I examined many formicaria subsequently, and invariably found this lower tunnel wherever the inclination permitted its construction. I have no doubt that it is constructed as a drain, and that the ants know as much about the advantage of thorough drainage as they have been proved to know, by many eminent observers, of those of other sanitary matters. On opening the mound, some three feet below the sur-

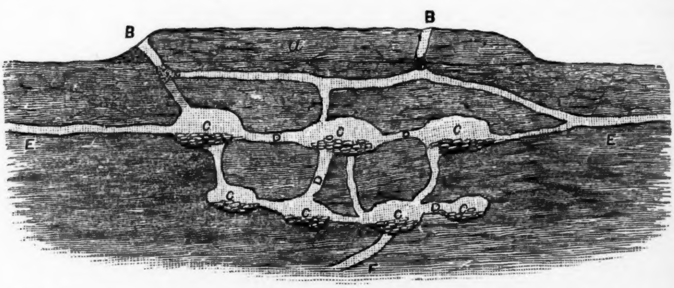

FIG. 7.—Diagrammatic v. section of an Œcodoma formicarium, depth about eight feet. *a*, mound of clayey granules; *B*, unused entrance; *C*, chambers containing leaves; *D*, connecting corridors; *E*, tunnels to distant entrances; *F*, drain from lower level of mines.

face was found a series of hall-like cells, some three feet in their larger diameter, connected with each other by short smooth corridors. From the outermost of these proceeded the tunnels communicating with the surface by the orifices mentioned above. Below there was a second series of somewhat smaller cells, the lowest of which was entered by the drain just referred to. The central chambers were all washed out, but several of the lateral chambers had escaped damage. In these were found bushels of leaves, several of the large cyclopean ants, many nurses, larvæ, and an Amphisbæna. This lizard is generally a guest of the

parasol ants, and repays their hospitality by feeding upon them. The natives firmly believe that the "serpent a deux tetes," as they call it, is the mother of the ants, and that they procure the leaves for the purpose of feeding it.

The larvæ were imbedded in a soft woolly matter which proved to be the finely masticated parenchyma of the leaves. Thus a use was found for the leaves, although it reflects seriously upon the supposed sagacity of the ants that they should procure so many more than are required for the purpose. Bates states that the leaves are also used for thatching the domes over the entrances to the mines, but I have not observed this practice in connection with the Trinidad species. The larvæ are fed by juices secreted by the nurses. A part of the larvæ emerge from the eggs winged and ready for their nuptial flight. These are the males and females, and the swarming occurs during the wet season. The female measures an inch in length and two inches in expanse of wing. The wings are clear, transparent and coarsely veined. The winged males and females emerge from the woods in clouds during the rains of April and May. These are almost all destroyed by the flycatchers, jackamars, ant-thrushes, &c., which greedily devour them; only a few impregnated females survive the slaughter to found new colonies and propagate their race. The colony is sustained, I suppose, as in other species, by the seizure and detention of impregnated females by their own subjects. After impregnation the female loses her wings, these being broken off by the insect itself. There may be noticed a natural suture at the base of the wing, doubtless that this may be easily broken off when no longer required.

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THE TEREDO, OR SHIPWORM.

BY R. E. C. STEARNS.

THERE are several species of what are popularly called "shipworms" which are ordinarily included under the name Teredo. Although to the common observer they have a worm-like appearance, they are not worms, but true shell-bearing mollusks, as much so as the common "long clam," "long-necked clam" or "mananose" (*Mya arenaria*) of the Atlantic coast of the United States.

So much has been written in relation to the shipworms that it

would be nearly impossible to write anything that would not be a repetition or quotation. The shipworms (Teredo) were known to the ancients, and Theophrastus, the friend and successor of Aristotle in the lyceum at Athens, observed their operations 350 B. C.

The late Dr. J. Gwyn Jeffreys,[1] in his excellent volumes on the mollusks of Great Britain, presents in a very concise and interesting way what is in fact a most valuable memoir on the shipworm, Teredinidæ.

The shipworms are *bivalves*, that is to say, the complete shell is in two pieces, although one can form no idea of the Teredo from them, as the shelly part is but an insignificant portion of the entire animal, as you will learn from the following:

"The Teredo * * * consists of a long and nearly gelatinous, worm-like body, without rings or segments, terminating at one end in a pair of * * * valves that somewhat resemble the two halves of a split nutshell which has had a large slice cut off at each side, and at the other in a pair of symmetrical shelly paddles with handles of different lengths, which close this extremity at the will of the animal. The open part of the bivalve shell is placed at the further end, and receives a circular disk of a fleshy or rather muscular nature, which may be termed the foot; this is the broadest and widest part. Inside each valve is seen a curved process, like a bill-hook, that projects from the hinge at a right angle. The shell covers and protects the mouth, palps, liver and other delicate organs. The body tapers gradually to the outer or nearer end, where it becomes quite small and attenuated; it contains the gullet, intestine and gills, which form at the outward point two cylindrical tubes, mostly of unequal length. The larger tube takes in infusoria or similar animalcules, which constitute the food of the Teredo, as well as imbibes water charged with air for the purpose of respiration and keeping the whole fabric moist, while the smaller tube is employed in the ejection of the water which has been exhausted or deprived of aeriferous qualities, and also serves to get rid of the woody pulp that is excavated by the Teredo. Both tubes form a kind of hydraulic machine. At the base of each lies one of the paddles often termed 'pallets.' * * *

"When the Teredo is alarmed, or not feeding, it withdraws its tubes into the neck of its sheath or shelly cylinder; and the pallets which had been previously kept pressed against the sides, then spring forward and close the opening so as to form an efficacious barrier against all foes," etc.

[1] British Conchology, Vol. III, pp. 122–184. See also the Dictionaire Universal d'Histoire, Vol. XII, p. 358, under the title "Taret," and the Encyclopedia Britannica, Vol. XV, p. 353, under "Mollusca."

"The whole of what I have endeavored to describe is found only within some hard vegetable substance, either the hull of a vessel or boat, a harbor pile, a shipping stage, a floating tree * * * a beacon or buoy," raft timbers, old spars and masts, the planking or bracing of wharves, bridges, &c., &c., and old hulks or wrecks. The Teredo bores into these the same as a

1, outside of one of the shells; 2, inside ditto; 3–3, pallets; 4–4, siphons.

rabbit or mole in the earth, making a continuous gallery or hole quite smooth inside and cased or lined with shelly matter forming the sheath or cylinder above described. This shelly wall or lining or cylinder is so fragile that it is quite impossible to split the wood containing one and get it out or even a portion of any considerable size; the blow necessary to cleave the wood shatters

the shelly lining of the Teredo's gallery or burrow into countless pieces.

These burrows vary from one quarter of an inch or less to half an inch or more in diameter.

It is only in its very earliest stages that the Teredo is a free moving animal. At this time no one other than a practiced naturalist would be likely to recognize it. "It is very minute, nearly spherical, and covered with cilia or hair-like projections, by means of which it swims rapidly through the water. In thirty-six hours it assumes a new form, and speedily changes it for another, after which it returns again to its original form, so that in a very few hours the little creature is first spherical, then oval, then triangular, and then spherical again. In this stage of existence it possesses a foot which enables it to crawl after the manner of snails, and also has organs of hearing and sight."

It does not enjoy its locomotive powers for any long time but fixes itself to some suitable object, passes through its last change, becomes a veritable shipworm and begins its lifelong task of boring.

The Teredo is not very particular as to the kind of timber into which it bores, but always goes with the grain, unless it meets with some obstacle, such as a nail or a very hard knot; and in such a case it turns out of its track for a short distance and then resumes its former course. As it bores its way along, it lines the tunnel (as before stated) with a coating of shelly matter, but this is not attached or in any way connected with the body or substance of the shipworm.

It is not believed that the wood it perforates furnishes any nutriment to the animal, but that its sustenance is derived entirely from the water which is constantly passing through its body.

The holes made in the wood at the time or just after the young Teredos commence burrowing are quite small, the appearance of the surface of a pile or other infested timber is usually deceptive, affording but little evidence of the size or number of the burrows or the extent of the ravages within. After awhile the interior is so completely "honeycombed" that a slight blow or bump by a vessel upon the outside shatters the pile, &c., and their damaging work can be seen.

Upon the water front of San Francisco I have known piles, of Oregon pine and fir over a foot in diameter, rendered worthless in

eighteen months, and have heard of even a more rapid destruction of wharf piles in the harbor of that city. In one instance reported to me the destruction was accomplished in about six months. In the case which came under my notice, as above, the wood of the pile had not lost its original fresh or bright appearance when it had to be removed from the wharf and a new one put in its place. My friend, Mr. Dall, informs me of a case of the destruction of the supports of a small pier made of piles (probably pine) six to eight inches in diameter in about six *weeks.* The structure was at one of the small capes near the entrance to Chesapeake bay.

As the shipworms are gregarious, and furthermore as they grow and multiply with astonishing rapidity, their destructive work is, as shown above, often accomplished in a very short time.

The extent of their operations and the money loss entailed thereby, both upon private parties and business corporations engaged in commercial marine enterprises and on the naval equipment and appurtenances of the great maritime nations, are enormous.

This has led to a great number of experiments by governments and inventors for the protection of wood work used in marine structures.

Jeffreys remarks that "in all probability the constitution of a shipworm is poison-proof." Most of the remedies proposed in the last century were of this nature, and they signally failed.

The saturation or impregnation of the wood with creosote or some other carbolic preparation by hydrostatic pressure, the kyanizing of piles, and sheathing with copper, the filling of the exposed surface with large-headed nails have all been tried. The two last, copper sheathing and scupper nailing, Jeffreys says, "have been successfully used, but the former is expensive and the crust of iron (unless they are closely driven in so as to completely cover the piles) is superficial and liable to scale off. I have known the Teredo to bore through a pile which was supposed to be protected by large broad-headed nails in the usual way. At Christiania, in April, 1863, I found that *Teredo navalis* was very destructive to the woodwork in the harbor, and to boats lying at anchor in the fiord. The chief engineer told me that all the piles had been creosoted (ten pounds to the square foot) before they were driven in, but not to much purpose!"

Certain kinds of wood are less subject to their attacks than others. The tree palmetto of the Southern States, it is said, is never bored by the shipworm, and some of the Australian woods have similar immunity. Dr. Mueller says of the *Eucalyptus marginata* (Smith): "The Jarrah or mahogany tree of S. W. Australia, is famed for its indestructible wood, which is attacked neither by Chelura nor Teredo nor Termites, and therefore so much sought for jetties and other structures exposed to sea water, also for underground work, and largely exported for railway sleepers. Vessels built of this timber have been enabled to do without copper sheathing. It is very strong, of a close grain and slightly oily and resinous nature; it works well, takes a fine finish, and is by shipbuilders here considered superior to either oak, teak or indeed any other wood." * * * The *E. rostrata* (Schlecht), the red gum of Victoria, is another very valuable species for the "extraordinary endurance of the wood underground, and for this reason highly valued for fence-posts, piles and railway sleepers; for the latter it will last a dozen years, and if well selected much longer. It is also extensively used by shipbuilders. * * * Next to the jarrah from S. W. Australia, this is the best wood for resisting the attacks of seaworms and white ants. This species reaches a hundred feet in height."

In some of the seaports in different parts of the world there are small crustaceans that assist the shipworms in cutting away what wood the Teredo may leave. These little fellows resemble the wood-louse (pill bug), and cut either way of the grain of the wood.

In the inlets around Puget sound the destructive action of both classes of animals may be seen, especially about the time of the summer solstice, when the extraordinary fall of the tide exposes the piles (of the wharves) for their entire length. A space measured up and down on the piles for a length of four or five feet, including the portion exposed between *ordinary* tide marks, may be seen which is so completely riddled that it would seem as if the slightest loading of the deck of the wharf would result in a tumble down of the whole.

The wood-eating crustaceans referred to belong to the groups Limnoria and Chelura.

As an offset to the damage caused by these, from point of size insignificant animals, it should be borne in mind, to their credit, that by destroying old wrecks, &c., in channel ways and at the entrance to harbors, they contribute to the safety of navigation.

It is stated also that the operations of the Teredo suggested to Mr. Brunel his method of tunneling the Thames.

THE FLOOD ROCK EXPLOSION.

BY WILLIAM HOSEA BALLOU.

THE greatest artificial earthquake in history occurred on Saturday morning, October 10, at 11 h. 14 m., standard time. The point of disturbance was Flood rock in East river, on the imaginary extension of Ninety-third street of New York city. The earthquake was projected by means of 300,000 pounds of dynamite and rackarock powder arranged in twenty-two miles of metallic cylinders. It was entirely submarine in character, and surface damage was prevented by a tamp of fully 10,000,000 cubic yards of salt water. As a spectacle it was simply an Icelandic or Yellowstone geyser on an extended scale—a sudden rise of water and gaseous smoke to a height of 150 feet for a length of 400 feet and a maximum thickness of 100 feet at the base of the column. The flying rocks and débris sketched in illustrated newspapers are the fickle inventions of inane minds. The column of upheaved water was so enormous that all solid bodies were hidden from vision. The explosion was comparable to a very good earthquake.

Inadequate observations.—Seismological observations were taken at various points, but the arrangements for so doing were inadequate and quite primitive. This is a statement of fact, not reflecting in any manner on the observers. In the first place there were no seismometers or seismographs in this country. In the second place the engineer corps and scientific corps did not act in conjunction with each other, and the latter received no telegraphic warning of the exact moment to expect the shock. In the third place observers were not stationed at sufficient distances from the center of disturbance to measure the length of radii of earth vibrations. Had there been seismographs located at Buffalo, Montreal, Philadelphia, Washington, Portland, Me., far out at sea, or at intervals on a direct diameter, say 1000 miles long, the exact length of the radii might have been determined. Furthermore, seismographs make an intelligible record with the pencil which none of the observers secured.

Results of scientific observations.—The record obtained by the scientific corps, however, was exceedingly interesting and valuable. There were a number of astounding as well as expected results. The instruments used were the seismoscope, the tele-

scope in connection with a horizontal plane of mercury, the sun thermometer, the thermometer, the barometer, the pluviometer, etc.

The shock did not create as much noise as an ordinary field piece.

The shock was felt by the feet and indicated by the seismoscope one-half a second before the result was visible to the eye.

The seismoscope, which is supposed to record the beginning of the shock simply, traced an unintelligible record on the sidereal time cylinder at the Columbia College observatory.

Observers who watched horizontal planes of mercury through telescopes naturally report different results. Professor William Halleck, at Yonkers, N. Y., ten miles from the explosion, records that the vibration of the mercury increased after the first fifteen seconds up to forty seconds, then diminished for ten seconds, ceasing entirely after fifty seconds. Professor J. K. Rees, at the Columbia College observatory, two miles away, and Professor Young, at Princeton, record that the duration of vibration of the mercury was thirty seconds. Professor W. A. Rogers, at Harvard College observatory, 197 miles away, records that the vibrations lasted there two minutes and forty-six seconds. This would show that the earth wave divided constantly as it traveled outward.

All of the instruments of the Central Park observatory left a record very much to the amazement of Professor Daniel Draper and other meteorologists. Why, for instance, should such a disturbance in any way affect the sun thermometer and rain gauge? The former recorded 121° in the sun, when suddenly the pen, which was tracing its record on paper, made a straight mark eight degrees long at right angles with the regular tracing and with four degrees on each side of it. This would naturally show a decrease or increase in the sun's temperature, whereas it was really an interruption of the sun's record by an abnormal cause. Professor Draper thinks that this record must be of great value to seismologists. I think it shows that the record of a sun thermometer, as indicated by a tracing on paper, cannot be relied upon, since any jar is liable to affect it. The pluviometer, or rain gauge, also gave an uncalled-for record of one-eighth of an inch. While these records may be of value to some one who can utilize them, to my mind they only demonstrate the fallacy of placing any value on the record of these instruments as traced on paper.

The atmospheric wave.—The vibrations of the air were exceedingly slight, owing to the heavy tamp of water. The greatest fall of the barometer was .02 of an inch. The wind being in the west and blowing eight miles per hour, the slight atmospheric wave was naturally carried out to sea, so that its duration and extent are lost.

The earth wave.—The velocity of the earth vibrations was one mile in seven-tenths seconds at the outset, decreasing to one mile $\frac{194}{197}$ths seconds, as far as measured. The notated diameter of the shock was 394 miles long. It is safe to approximate the diameters (supposing that observers had been on the watch at sufficient distances) at 800 miles. For if the shock was sufficient to reach the Cambridge observatory, 197 miles distant, in 194 seconds, and shake that eternal structure as it had never been shaken before, it ought to have doubled the distance with some perceptible effect, giving a radius instead of a diameter of 394 miles.

Scientific value of the observations.—The Flood rock explosion cannot be called a surface disturbance because it occurred at the sea level. Volcanic and geyser eruptions vary in altitude and have a vibratory power downward. All of the vibratory power at Flood rock was upward, which makes its effect all the more wonderful, since the farther the shock traveled the more of the earth surface it had to lift on account of the constant rise above sea level. Enough explosives were used to have obliterated Manhattan island if placed on the surface, or to have leveled Mt. Washington. The fact that 300,000 pounds of explosives will affect a surface of 300,000 square miles does not necessarily settle the question as to the cause of earthquakes. It does not verify the belief that explosions of some kind cause earthquakes, but leaves us in the dark as to the composition of such explosives. What mighty ingredients combined to lift the bowels of Krakatoa five and ten miles in the air, and so envelope the whole globe in a nebula of dust that the sun turned green and the sunsets were framed in gorgeous hues, lighting up the night long after the orb had disappeared? What mighty ingredients combined to explode Java and overwhelm 100,000 people? What chemicals combine beneath the Yellowstone park and hurl the boiling waters from Old Faithful geyser every hour, from the Minute Man once per minute, from clusters of geysers all at once every day at 4 P. M., from Hell's Half Acre once per year

or so, when this huge basin all boils up at once in one immense cauldron of seething waters? Flood rock answers these questions in part. It says that explosions of some kind do the work; but this answer only opens the door and points to a sea of data yet to be secured as to the nature, component parts and *modus operandi* of these explosions, which differ evidently in different cases.

Note.—The seismological observations to determine the duration and extent of the earth and atmospheric waves were taken on two lines running at right angles with each other. General Henry L. Abbot, of the United States Corps of Engineers, had charge of the observatories on an east and west line on Long Island, with headquarters at Willet's point. The north and south line was in charge of Professor F. W. Clarke, of the United States Geological Survey, Washington. He had his southern station on Staten island, in charge of Professor H. M. Paul of the United States Naval observatory. At the next station, on Ward's island, Professor T. C. Mendenhall, of the United States Signal Service, and himself observed. At Yonkers Professor William Hallock, of the United States Geological Survey, and student Thomas Ewing, Jr., of Columbia College, occupied a station. The most northerly observatory of the chain was at Vassar College, in charge of Professor Maria Mitchell. Dr. Daniel Draper took observations on a number of instruments at Central park. The astronomers at Princeton, Harvard and Rutgers colleges also made observations in conjunction with the others.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— It is safe to say that the greatest necessity of scientific progress in the United States to-day is schools and academies of original research. We have colleges and universities enough in most of the States, but there has not yet been established a single school where knowledge is produced, which corresponds in scope with the numerous institutions where it is taught. Perhaps it is a general impression that there is already more knowledge in the world than can be learned; but, if this be true, it can not for a moment obscure the greater truth, that most of the laws of nature remain still, more or less, unknown. It is, or ought to be,

well known, that all the knowledge taught in the schools is the product of original research, and that all books of any value in libraries, excepting works of the imagination, are derived from the same source. Hence, it appears that the absence of schools of research is a phenomenon for which it is difficult to account. There are some schools of this kind which cover a limited part of the field of knowledge, such as the summer schools of biology on the coast; and there are some museums where a limited amount of research is conducted, as much as their financial and intellectual resources permit. But these institutions are either so limited in means, or so completely under the control of non-investigators, that they are ineffective at present, or offer no prospect of progression in the future.

If any public-spirited citizen desires to erect for himself a unique and enduring monument, such can not be more effectively and usefully done than by the endowment of an Academy of Original Research. Such an institution would be a perpetual spring and source of knowledge and truth, and a living "nucleus" in the great organic body of society.

An institution which should cover most of the ground might be organized on the following basis: Six departments might be established, namely: 1, Astronomy; 2, Physics; 3, Chemistry; 4, Geology; 5, Vegetable Biology; 6, Animal Biology. For each of these departments the annual expenses would be as follows:

For salary of director	$3,500
For salary of assistant	1,000
For material (apparatus and specimens)	3,500
For books	500
	$8,500

which is, for the six departments, $51,000. Then there should be $7,000 per annum for publications, leaving $2,000 for janitor and other necessary expenses. The total income of $60,000 represents an endowment of $1,000,000. Of course, the details might be varied according to probable necessities, etc. And for a smaller endowment, fewer departments might be created, but not without seriously crippling the institution. Various details, such as the boundaries of the departments, the duties of assistants, etc., would have to be fixed. A certain number of lectures should be given by the directors, which should serve as an index of the characteristics of the workers and their work.

In the selection of the men who should act as directors of the departments, the principal difficulty is to be encountered. The enterprise of the American is no less marked in the struggle for place and reputation, than in the struggle for the almighty dollar. Qualification is little thought of by too many persons, who from physical or mental weakness, or some other cause, desire to live without labor. The charter of an institution of research should embrace a provision, that the position of director should be forfeited by that one who should not produce some original work of merit every year or two, or during some other definite time. In no other way could the institution be preserved from the intellectual decay into which so many have fallen; and in no other way could it be protected from patrons whose kind intentions might include personal favorites unknown to scientific research. Men of money who desire to sustain original research will be compelled to devote some inquiry as to who are the men who are loyal to this work. The best index they can find to this class is the record of their work already done.

The best mode of government of such an institution would be by a senatus composed of the six directors of the departments and an equal number of trustees of the endowment. In this way the greatest amount of wisdom would be brought to bear on the two questions of administration, viz.: the preservation of the fund, and the manner of its expenditure.—*C.*

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RECENT LITERATURE.

THE UNPAIRED FINS OF SELACHIANS.[1]—Dr. Paul Mayer, under the above caption, discusses the median fins of Selachians and throws new light upon a number of morphological questions which have lately arisen. He carries Dohrn's conclusions still farther, and has actually discovered at the end of the tail and on the back of the young embryo of Pristiurus and of Scyllium homogeneous structures (Hautknöpfe) of subepiblastic origin, of the same substance as the horn-fibers or actinotrichia in the fin-folds. These button-like structures are found on the back of the embryo, in a single row, on either side of the median line and in advance of the permanent dorsal. At the end of the tail they are in two rows, viz., a dorsal and a ventral series. In both situations they are metameric in position, and sections show that temporary muscular buds are thrust outward towards these singular lateral larval organs from the muscular segments or myotomes in the same way as to the bundles of fibers or actinotrichia representing rays in the median and paired fins.

These remarkable organs Mayer regards as the vestiges or remnants of parapodia, and therefore names them *parapodoids.*

[1] *Die unpaaren Flossen der Selachier.* Mitt. Zool. Stat. zu Neapel. VI, pp. 217–285, pl. 15–19. 1885.

At the tip of the tail they stand in the position of the caudal neuropodia and notopodia of errant annelids, but are not, as in them, constituted of palea, bristles, etc. In the anterior dorsal region of Scyllium, these bodies are in the position of neuropodia.

It will thus be seen that Mayer supplies a most important set of data which lend support to the views of Dohrn as to the meaning and origin of the median and paired fins, since that author has contended that the relations of these peripheral structures to the axis of the body are to be determined by the relations they bear to the myotomes which send out muscular buds into the fins, and not on the basis of the relations to the cartilaginous appendicular skeleton or spines, as held by most other morphologists.

The table which Dr. Mayer gives to illustrate the varying relations of the same metameric elements of the median fins to the point where the vertebral axis becomes diplospondylic are also of great interest, not only morphologically, but also taxonomically. For the first time in the history of the subject, in fact, we have presented in this paper a tabulated statement of what are the actual relations of the metameric elements of the vertical fins to the myotomes of the body and the sclerotomes and nerve-pairs of the axis in the principal families of Elasmobranchii. The paper also illustrates the perfection and resources of modern biological methods. It is to be regretted that the author does not give a brief summary of his results at the close of the paper.

These researches, it may be remarked in conclusion, also show that in Scyllium there is developed a posterior terminal, vermiform section of the embryo which corresponds to what the writer has called an opisthure. Though it is obvious that this opisthure is rudimentary and evanescent, as it soon becomes inconspicuous. Some of the Elasmobranchii, therefore, pass through what the writer has termed an archicercal stage.

The results reached by Dr. Mayer also afford important evidence in support of the archistome theory, published by the writer in this journal recently.[1]—*John A. Ryder.*

Bower and Vines' Practical Botany.[2]—One of the significant signs of the times, so far as botany is concerned, is the multiplication of books which are designed to encourage the practical study of plants in the microscopical and physiological laboratories. A few years ago, such a thing as a laboratory manual for the guidance of the botanical student was unheard of; now we

[1] American Naturalist, November, 1885, pp. 1115–1121.

[2] *A Course of Practical Instruction in Botany.* By F. O. Bower, M.A., F.L.S., Lecturer on Botany at the Normal School of Science, South Kensington; and Sidney H. Vines, M.A., D.Sc., F.L.S., Fellow and Lecturer of Christ's College, Cambridge, and Reader in Botany in the University. With a preface by W. T. Thistleton Dyer, M.A., C.M.G., F.R.S., F.L.S., Assistant Director of the Royal Gardens, Kew. Part I., Phanerogamæ–Pteridophyta. London, Macmillan & Co., 1885.

have half a dozen or more, each giving valuable and needed help to the young investigator. The latest of these manuals is the one now before us.

The book, we are told in the preface, is the outgrowth of work done in the Normal School of Science at South Kensington, during several years under Mr. Dyer, and afterwards to the present under Mr. Bower. Originating in this way, the book is not open to the objection of impracticability which so frequently may be brought against works of this kind, and the beginner may take it up with confidence that he is not asked to undertake that which for him is still impossible. A book which has *grown* into being is always helpful, and this will prove no exception to the rule.

There are in the beginning of the book a couple of introductory chapters in which are discussed briefly, and yet satisfactorily, the making of preparations—micro-chemical reagents, the general structure of the cell, the micro-chemistry and the micro-physics of the cell. Altogether, fifty-three pages are given to the foregoing topics.

In the succeeding pages are taken up first the Phanerogams and afterwards the Pteridophytes. The sunflower (*Helianthus annuus*) is taken very properly as the representative of the herbaceous, dicotyledonous angiosperms. This is followed by a study of the arboreal type represented by the elm (*Ulmus campestris*). The monocotyledons are principally represented by Indian corn (*Zea mais*). In the Gymnosperms the Scotch pine (*Pinus sylvestris*) is used for study. In each case, stem, leaf, root, flower and embryo are successively taken up and carefully studied. The same method is followed in the Pteridophytes, where Selaginella, Lycopodium, Aspidium and Equisetum represent the different types of structure.

The general plan of the work is the same as that of Huxley and Martin's well-known book, "Practical Instruction in Elementary Biology," and the faults of the present work are identical, as appear to us, with those of its forerunner. While such books are very useful, and while they are doubtless doing much to stimulate better work, we have long been of the opinion that altogether too much help is given in them to the pupil, and that he is not thrown often enough upon his own resources. It is true, of course, that in the laboratories of many teachers, books of this kind will not be used in such a way as to work to the disadvantage of the pupil, but in many other cases—in too many cases—they will be. In making these strictures upon the book, we would not be understood as criticising the method of study of which it is the outgrowth. As to that there can be but one opinion ; but unless great care be taken by the teacher and pupil, the results originally obtained at South Kensington without the book will not be secured with it. The book must be used as a *general guide*, and

must not be blindly followed paragraph by paragraph and page by page. Its proper function is *suggestive*, and, if so used, it will prove of great value in the botanical laboratory.

We cannot omit commending the form which the publishers have given the book. The type, printing, paper and binding are excellent, the flexible covers being especially commendable.—*Charles E. Bessey.*

TORREY'S BIRDS IN THE BUSH.[1]—This is a dangerous little book. Young naturalists who have chosen paths that are not those of song and color should avoid it, lest they also should, by its winsome sweetness, be charmed to become ornithologists. Birds appeal to other faculties beside those of the intellect. The musician, the poet, the painter, all find inspiration in the *oscines.* Perhaps this is the reason there is so much twaddle written about birds. Since there is an audience writers devoid of the artistic, poetical, or musical faculties pen a series of quasi-scientific meanderings, and send it forth as a bird-book. But Mr. Torrey loves bird-song and bird-beauty and tells his love in language remarkable for force and picturesqueness. The eleven chapters teem with the result of years of life among the birds, and the author has a quaint way of comparing bird-life and bird-ways with our own life and ways, without allowing the reader to forget that it is only a bird he is talking about. No heavier blow has been dealt the sparrow-hater than that given in the first chapter of this book. Though by no means a sparrow-lover, Mr. Torrey confesses that, in the space of the last seven oreight years, he has watched upon Boston Garden and Common some thousands of specimens, representing not far from seventy species. The author owns to the true aboriginal temperament—he loves to be out of doors, but hates out-of-door employment; this is the stuff ornithologists should be made of, plus eyes.

LOUIS AGASSIZ; HIS LIFE AND CORRESPONDENCE.[2]—The story of Agassiz's life, as here told, is an exceedingly attractive one, and we wish that a cheap edition of it could be published for the benefit of the youth of our country. The materials have been put together with much literary skill and judgment, the letters forming the larger part of the materials for the biography. To the American student who knew Agassiz, the first volume, relating to his boyhood, his youth at the universities, his early manhood as a collector and investigator, his life as a professor at Neuchatel, his correspondence with Humboldt, his nine summers spent in Alpine exploration—this volume will seem like a romance. To those who never saw this child of genius, the second volume, recounting his successful life in America, the land of his adoption, will be full of interest.

[1] *Birds in the Bush.* By BRADFORD TORREY. Boston, Houghton, Mifflin & Co.

[2] *Louis Agassiz—His Life and Correspondence.* Edited by ELIZABETH CARY AGASSIZ. Two volumes. Boston, Houghton, Mifflin & Co., 1885. 12mo. $4.

As a youth, Agassiz was indefatigable as a collector, personally attractive, full of high impulses, and his whole mind pervaded with the scientific spirit. His early dreams were fully realized; his castles in the air were actually built—he laid their foundations and saw the superstructures materialized in richly illustrated volumes and in brick and iron. The vast collections—the results of his journeys, of his passionate appeals to State and individuals, the unsolicited funds which flowed in as the meed of his success in winning the confidence and sympathy of scientific and lay men —these fill the Museum of Comparative Zoölogy, that monument of a life of rare devotion to high ideals.

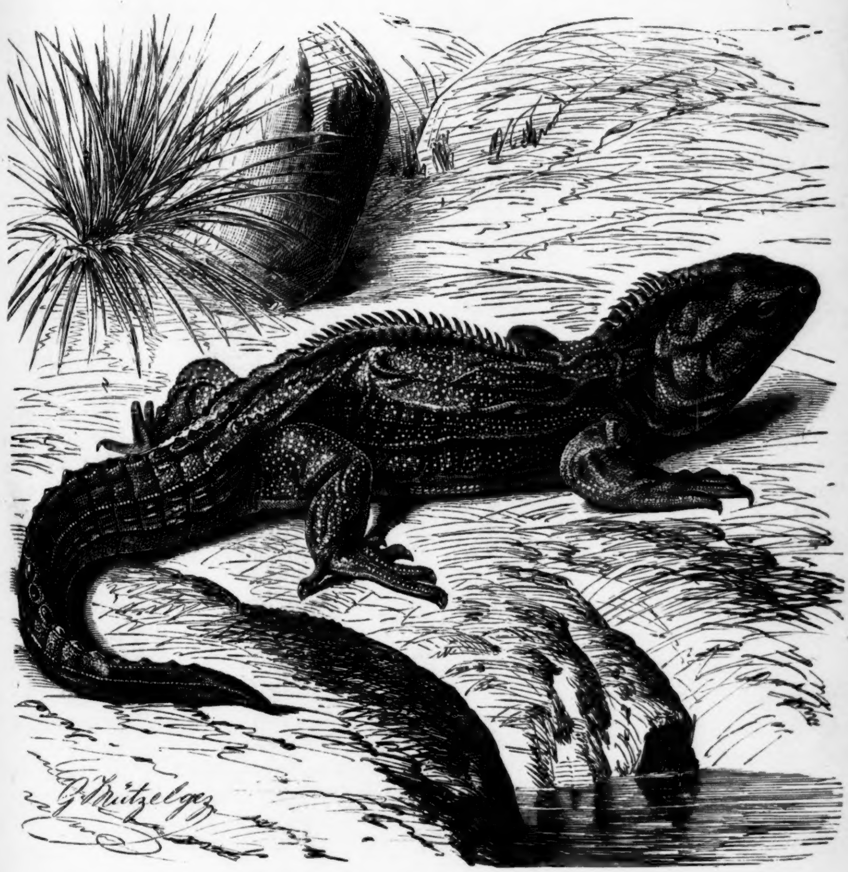
Agassiz was a genius. Winning in manner to an unusual degree, full of ardor and enthusiasm, often reckless, but always successful, with a grain of fanaticism and one-sidedness in his nature, like a knight of old he won his proud position as one of the leading scientific men of his age and the most influential and popular teacher in the New World.

Agassiz had great powers of generalization, side by side with those of acquisitiveness, of facts and specimens. His investigations in embryology, palæontology, as well as systematic zoölogy, led him to form clear views as to the geological succession of animals, the parallelism between the development of the individual and the group to which it belongs. His mode of looking at nature, the whole drift of his teachings, naturally prepared the mind for the reception of evolutionary ideas, and while his pupils and his contemporaries advanced naturally to these philosophic conceptions or generalizations, Agassiz,—whether owing to early prejudice, the lack of a judicial turn of mind and analytical powers, the modicum of combativeness and bigotry in his strong, intense nature, or the multiplicity of his labors and cares in the later years of his life, which gave him little time for sustained thought,—failed to rise to the grand generalizations of modern biology. He will be known in the history of science as the strongest opponent, after Cuvier, of the theory of descent.

Our Living World.—This work, now publishing in numbers, is, in the language of the title-page, an artistic edition of the Rev. J. G. Wood's Natural History of the Animal Creation. It is published by Selmar Hess, of New York, and edited for distribution in this country by Dr. J. B. Holder. The parts before us (27 to 32) finish the birds, discuss the reptiles and batrachians, and begin the account of the fishes. As will be seen by the samples illustrating this notice, the illustrations, which are mostly taken from Brehm's Thierleben, are very superior to any elsewhere printed, and give much value to the work.

The oleographs are also copies, by Mr. Prang, of those in Brehm's popular work. We should like to have had the remarkable characteristics of the New Zealand Sphenodon given. As it is

PLATE VIII.



The Sphenodon of New Zealand.

PLATE IX.

The Gannet.

it is regarded simply as the type of a family of ordinary lizards, whereas, by the best authorities, the group Rynchocephalia is regarded as a distinct order of reptiles of very primitive structure.

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—:o:—

GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ASIA—*The Rivers of the Punjab.*—An account of the rivers of the Punjab, by Gen. R. Macagan, occupies the first place in the November issue of the Proceedings of the Royal Geographical Society. Though Punjab means "five waters," the more ancient name was the land of the seven rivers, the Indus on the one side, and the Saraswati on the other, being added to the Jhelum, Chenab, Ravi, Beás, and Sutlej. The Saraswati rises in the low outer hills of the Himalayan mountains, and is now an unimportant river, except in the season of flood, yet it is described in the ancient writings of the Hindus as a mighty river like the others. But the Punjab was the tract first occupied by the Aryan immigrants from the north, and it appears more probable that the ideas of the people concerning the river changed when they knew it

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

better, and had advanced to the Jumna and the Ganges, than that the river should have altered so greatly. Yet the disappearance of the forests marks some diminution in the water-supply. Later writings, about the sixth century B. C., state that the Saraswati sinks into the earth, and gives the Ganges and Jumna at their confluence. This is probably a fable to save the credit of a sacred river. The Sutlej and the Indus rise on opposite sides of Mount Kailas, at elevations of about 15,200 and 18,000 feet respectively, and both flow north-west for a considerable distance, and then turn to the south-west, the Indus taking the wider sweep, and enclosing, between itself and the Sutlej, a broad tract containing the other four rivers and their drainage basins. Much of the upper courses of all these rivers is torrential, but the Indus runs with a gentle and winding current through Ladak at a height of 11,000 feet, and the lovely valley of Kashmir is situated near the sources of the Jhelum, which is even there a large river, since several tributaries join at Islamabad, forty miles above Srinagar. At Baramula, the Jhelum leaves Kashmir, and falls thirty-five feet per mile for seventy-five miles, and then twenty-one feet per mile to the Punjab plains. The earliest of the metrical histories of Kashmir state that the valley was once a lake, and that a powerful sage cut the gap at Baramula. It is not impossible that it was the work of man. Seventy-five miles of the upper course of the Beas have a fall of 125 feet per mile. The courses of all these rivers after reaching the plains of the Punjab are, like those of the Mississippi and other rivers which have flood plains, subject to much disastrous change. The rainfall of the higher portions of the Punjab, where the rivers leave the hills, varies from thirty-four to forty-eight inches. At fifty miles from the hills only sixteen to twenty-four inches of rain falls, and at 100 miles, but ten to twelve inches. Where the rivers unite, no more than six inches of rain falls annually, and still less than this visits the desert plain of Sind, through which the mighty Indus, after receiving the five rivers, flows to the ocean. The five rivers unite before reaching the Indus, and the united stream, called the *Panj-nad*, or five streams, is at the junction more than twice the width of the Indus, but much shallower. The discharge of the Panj-nad at the low season, is estimated at 69,000 cubic feet per second, that of the Indus at 92,000. The flood discharge below the junction is about 380,000 cubic feet. A very large amount of water borne down by these rivers sinks into the ground, and forms an underground reserve of water, which even in the rainless region round near the meeting of the five rivers is not more than twenty-four feet below the surface.

Some Himalayan Peaks.—According to notes communicated by Lieut. Col. H. C. B. Tanner to the British Association, there are no large glaciers on the north-east or shady side of Kinchinjinga, nor does Mt. Everest seem to have noteworthy glaciers. Kabru is

really a snow-clad table-land 24,000 feet high. Observations of Mt. Everest have to be taken from a distance of eighty miles, on account of the jealousy of the Nepalese government. As it is surrounded by peaks not greatly inferior in height, its aspect is not imposing, and the Tibetans look upon some other peak to the north or north-west as higher. The following table, given by Col. Tanner, shows the height above the sea of some of the highest Himalayan peaks, as well as the height of slope actually exposed to view.

	Height.	Height of slope exposed.
Everest (or Gaurisankar)	29,000	8,000
K² (Kashmir boundary)	28,278	
Makalu (No. XIII)	27,800	8–9,000
Nanga Parbat	26,600	23,000
Tirach Mir (Hindu Kush)	25,400	17–18,000
Rakaposhi (Gilgit)	25,560	18,000
Kinchinjinga	28,160	16,000

Mont Blanc, though only 15,781 feet high, presents a face of 11,500 feet.

M. Potaneri's Journey.—M. Potaneri has made interesting discoveries in Northwest China. The broad valley of the Tchitai, a tributary of the Hoang-ho, is thickly peopled by Salars (Turcomans), its upper part by Tanguts. The right bank of the Hoang-ho itself, near San-chuan, is also peopled by Salars. They maintain their Turkish language, and the Mussulman religion, but their mosques are Chinese in style, and the men wear a Chinese dress. The women wear broad trousers, an overcoat with sleeves, and a pointed bonnet. Above the gorge near San-chuan (excavated in the red sandstone and conglomerates which underlie the Loess), is a depression seven miles long, peopled exclusively by Mongolian Shirongols, who seem to belong to the same stem as the Dalda of Lake Kuku-nor. The Chinese call both Tu-jen. They speak Mongolian, with some Chinese words, and dress like Chinese, but the women wear trousers like the Salar women. Around He-cheu they are Mussulmans, but Buddhism and the teachings of Confucius are followed by some.

Asiatic News.—M. Ivanoff has recently described in the *Izvestia*, the remains of Akhyr-tash, at the foot of the Alexander range in Turkestan. The area covered by the remains is 20,900 square yards, and the stones weigh each about a ton. Some stone idols and a burial-ground on the Tssyk-tul are also described. ——The Kampti villages on a tributary of the Irawadi, visited by Wilcox, sixty years ago, have again been visited by Col. Woodthorpe. Only a very ordinary road is required to open up a trade with these people from Assam.——Mr. Gardner considers Mukden, the capital of the Mongolian province of Fêng-Tieng, as one of the finest and most prosperous cities of the Chinese empire. The population of the province is chiefly Chinese. In 1865 it was a neutral belt, which neither Chinese nor Coreans

were allowed to colonize. Since 1876 hundreds of thousands of emigrants have arrived from Shantung and Chihli, and have broken up and cultivated land on both sides of the Great Wall or Palisades. The site of Newchang, the port of Fêng-Tieng, was in the seabed up to the beginning of this century. The province of Korin contains a large community of Coreans.——About 48,000 square miles, or 5½ per cent of British India, has been reserved as forests. Some are upon the plains or on the low ranges of hills rising from them, some on the lower or middle slopes of the Himalayas to an elevation of 8000 to 9000 feet. A forest survey is in progress, largely in the lands of native surveyors trained in the Forest Survey Department. A school of Indian forestry has been established, in which natives are trained to be conservators and rangers.

AMERICA.—*The Claims of France in Brazil.*—M. Condreau calls attention in a recent issue of the *Revue Scientifique* to the undetermined portion of French Guiana. Upon maps the river Oyapock is shown as the south-eastern boundary of French Guiana, separating it from Brazil, while the southern boundary is formed by the Tumac-Humac mountains. It appears, however, that France has at various times occupied and abandoned the territories between the Oyapock and the Amazons, and that the peoples of that region live actually independent of either Brazil or France. M. Condreau states that Brazil once offered to divide this territory, but that France claimed two-thirds. In any case, the country in dispute is worth having, since it is not an unhealthy marsh like Guiana itself, but an elevated healthy prairie country tilled for colonization. The region offered to France in 1856, between the Oyapock and the Carsevesme, is as large as three French departments; while that claimed by France, ending at the Tartarougal, contains twice the area.

M. Condreau argues for the acceptance of the Brazilian proposition. Arguments about rights make it clear to a Frenchman that France ought to own all the country north of the Amazon as far as the Rio Negro, and equally clear to a Brazilian that Brazil owns to the Oyapock. Diplomacy has tried to settle the matter for two hundred years. Most of this territory has been settled by Brazilians, but the coast and prairies back of it are occupied only by Indians. He proposes a Franco-Brazilian commission to settle the matter. The first need is a good map. The seaboard is subject to continual change, especially between the Mapa and Cabo Rase de Norte. During the last forty years much alluvial land has been made by the rivers. Of the interior country, and of the Island of Maraca next to nothing is really known.

American News.— Lieutenant Cantwell has explored the river Futnam to its source, 520 miles from the mouth. It rises in four large lakes; the largest is about 153° W. long. and 67° N. lat.

He found that there was an easy communication between Kotzebue sound and the Yukon.——Mr. B. McLenegan, with one sailor, ascended in a canoe the river Nortauk, which enters the Arctic ocean at Hotham inlet, for a distance of 400 miles. Here one of the head streams of the river issued from a small lake. No inhabitants were met with. The course of the Nortauk is entirely in the Polar circle, and the lake in which it rises is the most northerly inland point yet reached by white men in Alaska.——A rich deposit of coal of good quality has been found at Cape Lisburne (69° 37′ N. lat.).——From the observations made by the *Alert*, it appears that Hudson's bay and strait are navigable from July to October, and that the climate of the Hudson's bay coast is less severe than that of Northwest Canada.——Lieut. Allen has returned to San Francisco from an exploration of the Copper river, which he ascended as far as the mountain range of Alaska. He then crossed the mountains on snow-shoes, and reached the sources of the Tennah, which he followed 800 miles to its junction with the Takon. The latter he descended to its mouth, a distance of 400 to 500 miles.——M. Thonar has left Buenos Ayres to complete his explorations on the Pilcomayo.——Captain L. Gray found, during his visit to the east coast of Greenland last summer, that the land ice was sufficiently open in August to afford passage for a steamer. He sailed along the coast from Shannon island to the entrance of Scoresby sound.——J. Hughes and F. Dunsmuir have returned to Juneau, Alaska, from the headwaters of the Yukon. Good placers were found, mostly in British territory.——The governments of the Argentine confederation and of Brazil have agreed to a joint exploration of the neutral or disputed ground on the western limit of the Brazilian province of Sta. Cateria, situated between the Uruguay and Iguassu rivers. An old treaty between Spain and Portugal fixed upon two rivers, the Peperi and San Antonio, the first flowing into the Iguassu, the second southward to the Uruguay, as the boundary; but the difficulty is to identify the rivers so called in the treaty.——Lieut. Greely, in a recent lecture at Dundee, stated that the temperature observations taken during his stay in Grinnell sound confirmed the expectation that it had the lowest mean temperature known, about 4° F. below zero. The discovery of coal at various points showed how climate had changed. He doubted the existence of a palæocrystic sea. The floe bergs from 100 to 1000 feet thick, are, in his belief, detachments of slowly moving ice-caps from a land near the pole. In Kane sea he visited a floe berg a third of a mile wide and a fifth to a sixth of a mile thick, and found upon it two valleys thirty feet deep, along which were fully 100 large stones polished and worn smooth—proofs of the glacial and terrestrial origin of the floe.

Africa.—*Capello and Ivens' Journey.*—Messrs. Capello and Ivens reached Lisbon on Sept. 17th, after traveling 4200 geographical miles in Africa during fifteen months. From the Portuguese territory they proceeded towards the Cubango, as far as the lower part of the Tucussu, where the barrenness of the region, intersected by water-courses and marshes, forced them to turn northwards through a district infested by the tsetse. Sixteen of the party died of tsetse-bites, besides cattle and dogs. Sixty-two men perished during the fifteen months. The principal results of this journey are the rectification of the course of the Cunene, the determination of the Quarrai and its union with the Cubango, as well as the interesting hydrography of the Handa and the Upper Ovampe; the exploration of the Cubango between 15° and 17° S. lat., and of its principal eastern affluents; the investigation of the basin of the Upper Zambezi to Libonta, and the upper and middle course of the Cabompo; the discovery of the Cambai, an eastern branch of the Upper Zambezi; the exploration of the sources of the Lualaba and Luapula, and of the northern tributaries of the Middle Zambezi; and the identification of the Lœngue with the Kafuke. The great lake Bangweolo of modern maps is really composed of two smaller lakes, Bangweolo to the north, and Bemba to the south, separated by a marshy belt. This agrees with M. Giraud's account.

GEOLOGY AND PALÆONTOLOGY.

The Sternum of the Dinosauria.—The discussion which has been going on between palæontologists, as to the nature of the sternum of the Dinosauria, and the presence or absence of clavicles in this order, induces me to present some evidence which bears distinctly on the question. The first point to be noticed is the pair of bones represented in Fig. 1, which belongs to the skeleton of *Diclonius mirabilis* Leidy.[1] It is evident that these resemble very nearly the parts discovered by Dollo in the *Iguanodon bernissartensis*, in place, and referred by him to the sternum.[2] Not having been present at the exhumation of the Diclonius, I cannot give their exact relations. The positions in which the bones were found by Dollo in the Iguanodon renders it highly probable that they are the separate pleurosteal elements of the sternum. The long processes will then be posterior, and will have given attachment to ribs. Such a type of sternum is, however, unique, and requires good evidence before admission into our descriptions.

Important evidence on this point is furnished by the probable corresponding element in the Laramie dinosaurian, the *Monoclonius crassus* Cope.[3] This is a quadrupedal form, about as large

[1] Proceedings Academy, Philadelphia, 1883, p. 97.

[2] Bulletin du Musée Royal d'Histoire Naturelle de Belgique, 1882, p. 208.

[3] Proceedings Academy, Philadelphia, 1876, October; Pal. Bulletin, No. 22, p. 8.

as a *Rhinocerus unicornis*, with teeth approaching those of Hadrosaurus in characters. The accompanying figure 2 represents the element in question, one-tenth the natural size. Here the lateral elements are united on the middle line, which projects as an obtuse keel. The lateral processes are nearly transverse, and are impressed at their extremities by articular surfaces. The opposite extremity presents a facet on each side for a squamosal articulation with a flat bone (*c*, Fig. 2), in which the inferior bounding ridge projects much further than the superior one. This articulation cannot be for any other bone than the coracoid, and it resembles considerably the corresponding groove on the sternum of the crocodile. The general surface of the bone is dense, and does not resemble the imperfect ossification described by Hulke in the bone of similar character referred by him to

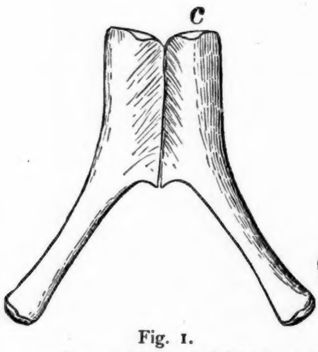


Fig. I.

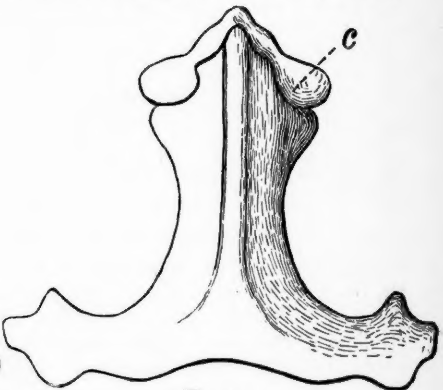


Fig. 2.

FIG. I, Sternum of *Diclonius mirabilis* Leidy ; FIG. 2, do. of *Monoclonius crassus* Cope; both one-tenth natural size; *c*, coracoid facet. From the Laramie beds of Dakota and Montana.

Iguanodon.[1] That the element in Monoclonius, represented in Fig. 2, is the sternum, seems very probable, and, if so, the elements in Diclonius (Fig. I) are sternum also.

The T-shaped bone figured by Hulke, if inverted, would resemble the elements here referred to the sternum in Diclonius and Monoclonius. Mr. Hulke describes a probable articular facet along its sides "posterior" (anterior) to the divergent bars, as suggesting an articulation with an epicoracoid. This may correspond with the facet *c* in Diclonius and Monoclonius, which, I suppose, received the edge of the coracoid. This justifies the proposition of Baur,[2] that this bone should be inverted, and that the supposed clavicles of Hulke and Marsh are posterior pro-

[1] Quarterly Journal Geological Society, 1885, pl. XIV.
[2] Zoologischer Anzeiger, No. 205, 1885, p. 2.

cesses of the sternum and not anterior. The evidence for this position rests primarily, I repeat, on the position of the bones observed by Dollo, and the character of the corresponding element in Monoclonius.

But it may be that the bone figured by Hulke is a different element from that figured by Dollo, as supposed by the latter.[1]

The proximal end of the scapula of *Diclonius mirabilis* resembles very much that which I have figured and described as belonging to *Hadrosaurus foulkei*,[2] excepting that it possesses a strong tuberosity on the anterior border (*spina scapulæ*), which is wanting in that species. It is represented as weak in the two species of Iguanodon by Dollo, and as rather strong in the same genus by Hulke.—*E. D. Cope.*

Corrections of Notes on Dinocerata.—In the Naturalist for June, 1885, I gave a synopsis of the genera of this suborder, which was partly based on new information derived from Professor Marsh's work, then recently published. Among them was included the supposed genus Tetheopsis, whose character consisted in the absence of inferior canine and incisor teeth. The discovery of species presenting such a peculiarity would not be at all surprising in view of the reduction which the roots of these teeth display in some of the species, and the absence of superior incisors in all of them. The character on which the genus was predicated is figured by Professor Marsh in the skull referred to *Tinoceras stenops* Marsh, without comment in the description which follows. I now learn on good authority that the symphyseal region in the specimen in question is entirely constructed of plaster of Paris. I saw the specimen, and a rather close examination did not reveal the line of separation between the plaster and the bone, which it is colored to imitate, and which is not indicated in either Professor Marsh's figures or description. The genus Tetheopsis must then be regarded as an artifact!

I add that the basal part of a skull which I described under the head of *Uintatherium lacustre* Marsh (U. S. Geological Survey, Terrs., III, p. 592) turns out to belong to a Palæosyops. The skull was found in a broken condition mingled with loose fragments and teeth of the Uintatherium in such a way as to lead to the belief that they belonged together.—*E. D. Cope.*

Discovery of lamellate thoracic Feet in the Phyllocarida.—In a genus of Phyllocarida, allied to Ceratiocaris, which is represented by a specimen from the Carboniferous beds of Mazon creek, Illinois, kindly loaned me by Mr. J. C. Carr, of Morris, Ill., there are plain indications of broad lamellate feet like the thoracic feet of Nebalia.

Of these limbs there are traces of four pairs. They are broad

[1] Revue des Questions Scientifiques, 1885, p. 8, top.
[2] Transactions American Philosophical Society, 1869, XIV, p. 92.

and thin, slightly contracted in width near the base, and at the distal extremity quite regularly rounded, with the free ends apparently slightly folded longitudinally, the edges appearing to be slightly crenulated, though the folds were perhaps due to changes after death. All the feet are of nearly the same size, and are about two-thirds as long as the carapace is high, being of nearly the same proportionate length as in Nebalia. There are no traces of a division into endopodites and exopodites, but we should be inclined to regard the parts preserved as the homologues of the exopodites of Nebalia.

This specimen, then, indicates the existence in extinct Phyllocarida of thin, broad, lamellate, thoracic limbs, in general appearance like those existing in Nebalia, and should this view be substantiated by farther discoveries it will prove the reasonableness of uniting Ceratiocaris and its allies with the modern Nebalia. I had a year ago considered this form as new and gave it a MS. name *Cryptozoë problematicas*, as I was in doubt as to its affinities; but lately submitting it to Mr. C. E. Beecher, with the opinion that it was a Ceratiocaris, he writes me that he regards it as new to science. A description of the new genus and species, with figures, will appear hereafter.—*A. S. Packard.*

Geological Survey of Pennsylvania.—Report of Progress x contains a geological hand-atlas of the sixty-seven counties of Pennsylvania, and is the work of J. P. Lesley, the chief of the survey. The volume is one which ought to be in the hands of every one interested in field geology, embodying as it does, in convenient form, the entire results of the survey, so far as they can be cartographically represented. The maps are prefaced by an explanation of the geological structure of Pennsylvania, and a short account of the characteristic features of each county.

Geological Survey of Minnesota.—Professor Winchell's Twelfth Annual Report commences with a summary statement of work done. From this it appears that maps of thirty-two counties are completed, and several others in course of preparation. A new trilobite of the genus Bathyurus is described. Professor Winchell gives an account of experiments with cubes of New England and Minnesota granites, and seems to prove the latter to be the stronger.

C. L. Herrick contributes a final report on the Crustacea of Minnesota (Cladocera and Copepoda). This occupies 191 pages, includes an account of the enemies of entomostræa, and appears to be exhaustive. It is illustrated with numerous plates. The volume concludes with a catalogue of the flora, by Warren Upham. It includes 1650 species, comprising vascular cryptogams, but not fungi or algæ.

Geological News.—*General.*—A. S. Woodward (*Geol. Mag.*, Nov., 1885) gives a list of the British fossil Crocodilia. One spe-

cies occurs in the Upper Trias, six in the Upper Lias, thirty-nine from the other Jurassic beds, eleven from the Purbeck and Wealden beds, three from the green sand, and six from the Eocene.

Silurian.—Dr. O. Hermann (*Geol. Mag.* Sept., Oct., 1885) gives an account of the organization of the Graptolithidæ. The entire polypidom proceeds from a simple hollow cone called the *sicula.* In the external wall of this dagger-shaped organ a single or double solid axis is developed. Thus, until the sicula is found, it is impossible to tell whether any given form belongs to the monograptidæ or to a two-branched family. Sprouting does not always commence at the same spot of the sicula. It is now assumed that all graptolites provided with a sicula were not attached bodies, the character of the termination, and its disappearance in full-grown individuals, militating against attachment. In some of the much-branched Dichograptidæ a central chitinous disc unites the basal part of the branches. It has been ascertained by Hopkinson that in some graptolites the hydrothecæ were separated from the cœnosarc by a well-marked septum, and that the cœnosarc was divided by septa into transverse joints. The oldest graptolite, according to Brogger and Hermann, is *Dictyograpius teneilus;* and the family Dichograptidæ, which includes complicated and elegant forms of graptolites, is older than the universal groups. This family appears in the Lower Silurian (Waring), becoming extinguished before the Upper Silurian is reached. The Phyllograptidæ and Lasiograptidæ seem to be confined to the lowest division of the Lower Silurian, the Leptograptidæ and Dicranograptidæ to the Lower Silurian, while the Diptograptidæ and Retiohtes commence in the lowest Lower Silurian, but are most developed at its upper boundary, and extend into the Upper Silurian. The simplest family, the Monograptidæ, are, according to Lapworth, strictly confined to the Upper Silurian. The genus Dictyograptus, of which Tullberg makes a new family (though Hermann ranges it with the Dichograptidæ), maintains itself through the entire Silurian, and passes into the Devonian.

Devonian.—Professor Williams has described (*Geol. Mag.*, Sept., 1885), *Prestwichia eriensis*, a new Limuloid from the Devonian of Le Bouf, Erie county, Pa.

Cretaceous.—The new facts regarding the fossil flora of the western Northwest Territory of the Dominion of Canada require the intercalations of three distinct plant horizons not previously recognized. One of these, the Kontame series, probably belongs to the Urgonian or Neocomian, or is at least not newer than the Shasta group. It seems to correspond to the oldest Cretaceous flora of Europe and Asia, and to that of the Korné formations in Greenland. The second or Mill creek series corresponds closely to the Dakota, and seems to represent the flora of the Cenoma-

nian and Turonian divisions of Europe. The third sub-flora is that of the Belly river at the base of the Fort Pierre group. Though separated from the Laramie by the Pierre and Fox hill groups, it introduces the Laramie or Dominion flora, which continues to the top of the Cretaceous, and probably into the Eocene, and includes several species still surviving in America. Next comes the Laramie group itself, the fossils of which are found in Canada, chiefly in the lower and upper beds, the middle beds being poor in plants. Sir W. Dawson concludes that no cause for the mild temperature of the Cretaceous other than change of elevation need be invoked.

Tertiary.—According to Woodward, fifteen species of fossil sirenians have been referred to Halitherium, while two considerably larger species, both found in Italy, are placed in Felsinotherium, and closely resemble Halicore in dentition. *Prorastomus sirenoides* Owen, from Jamaica, differs widely from all other sirenians, but is nearer Manatus than Halicore. The dental formula is i $\frac{3-3}{3\ 3}$ c. $\frac{1-1}{1-1}$ p. m. $\frac{5-5}{5-5}$ m. $\frac{3\ 3}{3\ 3} = 48$. Felsinotherium has i $\frac{1\ 1}{0\ 0}$ m. $\frac{5-5}{5-5}$. An interesting discovery was a cast of the interior of the skull of *Eotherium ægyptiacum* at Mokattam, near Cairo, in 1875. The brain of the huge Rhytina is only one-sixth of the size of that of the manatee or dugong. The total number of extinct sirenians enumerated by Woodward, including Chirotherium from Piedmont; Chronozoön from New South Wales; Crassitherium from Belgium; Dioplotherium and Hemicaulodon from South Carolina and New Jersey; Pachyacanthus from near Vienna; Rhytiodus and Trachytherium from France, and two extinct Manati, is twenty-eight. The recent species are three of Manatus and three of Halicore. Dr. Murie believes that the large number of fossil species described will probably have to be reduced into two or three genera.

MINERALOGY AND PETROGRAPHY.[1]

ETCHED FIGURES. — Under this general head are included etched figures proper (Aetz-Figuren of the Germans) and figures produced by weathering (Verwitterungs-Figuren). These were first studied, as early as 1816, by Daniell.[2] A little later, Leydolt[3] investigated the forms of the depressions on rough surfaces of crystals. Pape[4] next took up the subject. He drove off the water contained in many minerals and examined the shape of the figures resulting (Verstäubungs-Figuren). In later years, many other investigators have attempted to discover the relations between etched figures, those produced by weathering and the directions of cohesion in minerals. Baumhauer succeeded in proving that the shapes of etched figures were independent of the

[1] Edited by W. S. BAYLEY, Johns Hopkins University, Baltimore, Md.
[2] Quart. Jour. Sci., I, 1816, p. 24.
[3] Sitz.-Ber. der Akad., Wien, 1855, 15, p. 59.
[4] Poggendorf's Annalen, 124, p. 329, etc.

cleavage planes, but were intimately related to the symmetry of the crystal, and thus opened up a new method of investigating opaque minerals. In order to study more closely the connection between the figures produced by weathering and those produced by etching, Blasius,[1] of Strassburg, subjected a number of substances in crystal form to the action of alcohol, and also placed them in desiccators with strong sulphuric acid. As the result of a large number of experiments, he concludes that many of the figures produced by weathering (including etched figures) cannot be brought into close relation with the directions of cleavage or the curves of hardness in the substances acted upon. Moreover, their shapes differ according to conditions, and, finally, from a knowledge of the etched figures on a number of faces the shape of those on others can be deduced. F. Becke[2] adds further to our knowledge in an article on the etched figures of minerals of the magnetite group. Magnetite, spinel, franklinite and linnæite were treated with sulphuric, nitric and hydrochloric acids of different concentrations and during periods of different lengths, and besides with alkaline solutions. 1. On all the crystal faces, the figures were composed essentially of the same planes of etching, the principal planes of etching. 2. The principal planes of etching lie in a determinate zone. 3. These planes of etching offer the greatest opposition to the action of solvents. 4. Depressions are formed on such faces as belong to the zone of etching, elevations on those which lie far without it. 5. Cleavage planes cannot, at the same time, be planes of etching. 6. Linnæite, when etched with acids, deports itself like magnetite; when treated with alkaline solutions, an entirely different plane becomes the principal plane of etching. Consequently, it may be assumed that "the elemental atoms in the crystal molecule maintain a definite position with relation to one another." In linnæite (Co_3S_4), for instance, "the cobalt atoms are turned toward the cubic faces and the sulphur atoms toward the dodecahedral faces," because when treated with acid the cubic faces are dissolved fastest, but when treated with fused potash, the dodecahedral faces offer the least opposition to the solvent action of this reagent. Baumhauer[3] makes practical use of the method of etched figures in an investigation of the character of the massive bornite from Chloride, N. M. When a polished surface of this mineral is treated with nitric acid it breaks up into several fields, each of which reflects the light differently, showing that the massive material is made up of an irregular intergrowth of individual crystals. At the same time the fact is brought out that twinned inclusions of chalcocite and chalcopyrite are not uncommon.

[1] Zeits. für Kryst. und Miner., x, p. 221.
[2] Min. und Petrogr. Mitt., VII, p. 195.
[3] Zeitschrift für Krystallographie, x, p. 447.

Andesite.—The question of the best definition of andesite is again discussed by J. Siemiradzki[1] in an article on the rocks of Ecuador. Von Buch described it as a volcanic rock consisting of plagioclase and hornblende; and Lagorio as a volcanic rock composed of plagioclase, with the addition of augite, hornblende or mica. Rosenbusch[2] separates the mica and amphibole andesites from the augite andesite. Siemiradski finds that the same lava-stream varies in acidity, and that, though hornblende is more abundant in the more acid andesites, on the other hand augite and even olivine occur in very acid varieties, containing free silica, while hornblende is entirely lacking.[3] "No indication of the regular sequence of separation of augite, hornblende and mica with increasing acidity, as observed by Hague and Iddings,[4] can be detected." He suggests as the best definition of this class of rocks the following: Neutral or acid plagioclase rocks, with at least fifty-five per cent of SiO_2, with trachytic, basaltic or phonolitic habit, consisting of porphyritic andesine, with an iron-rich pyroxene, hornblende or mica in a groundmass, composed essentially of an acid andesine or oligoclase, and an acid glass (mixture of oligoclase substance and amorphous silica) containing microscopic pyroxene.

The porphyritic hornblende of these Ecuador andesites is surrounded by an opacitic rim and contains inclusions of the groundmass, which, under the microscope, are seen to consist of feldspar and augite microlites. Moreover, it is not confined to the most acid varieties. Consequently, the author suggests that it may have been produced, at great depths, in a magma saturated with superheated steam under great pressure, while the augite crystallized from a dry magma under comparatively little pressure—a theory very different from the one usually accepted.

Wildschönau Gabbro.—In a communication on this subject, Cathrein[5] calls attention to the article of Hatch, already noticed in these notes.[6] He claims that the latter's hornblende-gabbro and amphibolite are chlorite-gabbro and chlorite-schist, and that there are no proofs of the close relation which that author supposes to exist between normal gabbro and serpentine on the one hand and amphibolite and epidote rock on the other.

Petrographical News.—F. Becke[7] communicates a few notes on the rocks of the lower Austrian Waldviertel. At Marburg there occurs a granophyre in veins. It consists of zircon in small

[1] Geologische Reisenotizen aus Ecuador, N. J. B. Beil., Bd. iv, 1885, p. 195.
[2] Mikros. Phys. der Massigen Gesteine, 1877.
[3] Lagorio, Andesite des Kaukasus, p. 27.
[4] Notes of the volcanic rocks of the Great Basin. Amer. Jour. Sci., xxvii, 1884, No. 162.
[5] Miner. und Petrog. Mitth., vii, p. 189.
[6] Naturalist, October, 1885, p. 992.
[7] Min. und Petrog. Mittheilungen, vii, p. 250.

yellow grains, chloritized biotite, dark-green hornblende, clear transparent orthoclase and microcline and opaque altered plagioclase in a groundmass of small brown plates of biotite and clear orthoclase and quartz in micropegmatitic growths. Pilite-kersantite from Spitz on the Donau and pyroxene-amphibolite from Aschauer are also described. In the same article Becke reports the result of a reinvestigation of Schrauf's kelyphite,[1] the alteration product of pyrope in olivine rocks. This substance, he thinks, is a mixture of a chrome-spinel and a silicate, probably hornblende. The reaction of the olivine on the garnet he represents thus:

$$\underset{\text{pyrope,}}{Mg_3Al_2Si_3O_{12}} + \underset{\text{olivine,}}{Mg_2SiO_4} = \underset{\text{spinel,}}{Al_2MgO_4} + \underset{\text{amphibole.}}{Mg_4Si_4O_{12}}$$

——In a letter to the Neues Jahrbuch,[2] F. H. Hatch describes hypersthene andesite from Mt. Chachani, in Peru.——Inclusions of mica-schist, marble and syenite are mentioned[3] by Hussak as occurring in the phonolite of Oberschaffhausen.——The same writer[4] denies the widespread existence of cordierite in Hungarian andesites, but finds it in many trachytes.——Kolenko[5] mentions hornblende pseudomorphs after olivine as characteristic of a metamorphosed olivine diabase from the north shore of Lake Onega, in the Caucasus. The olivine substance is entirely changed into aggregates and crystals of a non-pleochroic hornblende.——Cathrein[6] communicates an interesting paper on the alteration of garnet in the amphibolites of the Tyrolese Central Alps. Pseudomorphs of epidote, scapolite, oligoclase, hornblende, saussurite and chlorite are described in detail. The scapolite substance is intimately mixed with epidote and plagioclase, and the whole is surrounded by a rim of hornblende crystals. In the change to hornblende, crystals of magnetite separate and the excess of silica, magnesia and lime unite to form epidote.

Miscellaneous.—In a discussion concerning the conduct of the zeolites with reference to their water constituent, C. Bodewig[8] shows that the loss of weight which phacolite suffers over $CaCl_2$ must be due to loss of water of crystallization and not to loss of hygroscopic water. He also contests the idea of Jannasch[9] that every desiccating agent abstracts a certain definite amount of water from these minerals and consequently *some* of the loss over $CaCl_2$ may be due to loss of water of combination.——The twelfth edition

[1] Ueber Kelyphite. Neues Jahrb. f. Miner., etc., 1884, II, p. 21.
[2] Band II, p. 73, 1885.
[3] Neues Jahrb. f. Mineralogie, 1885, II, p. 78.
[4] Ib., p. 81.
[5] Ib., p. 90.
[6] Zeitschrift f. Krystallographie, x, p. 433.
[7] Miner. und Petrog. Mittheilungen, VII, p. 250.
[8] Zeitschrift für Krystallographie, x, p. 276.
[9] Ib., VIII, p. 429.

of Naumann's "Elemente der Mineralogie"[1] has just appeared. The work has been newly revised and brought up to date by Dr. Ferdinand Zirkel, who has undertaken this duty since the death of Naumann in 1873. The new edition contains about fifty pages and thirty-three wood-cuts, more than the eleventh (1881). The chemical formulæ used have all been recalculated and the recent advances in the field of optical and physical mineralogy have been incorporated in the body of the work, so that the new book is the most complete and satisfactory treatise on general mineralogy published in any language.——An abstract from the forthcoming "Mineral Resources of the United States, Calendar Years 1883 and 1884," has just been received. It is entitled "Precious Stones."[2] The author is G. F. Kuntz. The paper treats of the production of precious stones in the United States in 1883 and 1884 and their importation. The total value of precious stones found during 1884 was $82,975, including $800 worth of diamonds. The gold quartz sold as specimens during this year is valued at $40,000, and that cut for gems or ornamental uses at $100,000. The value of the importations is estimated at $9,253,376. The most important finds during the year were as follows: At Auburn, Me., colorless, pink, blue and golden tourmalines to the value of $1500, and at Mt. Mica, in the same State, tourmalines, beryls and aquamarines to the amount of $4145. At Florissant, Cal., about $1000 worth of topaz was taken out. The reports in the newspapers of remarkable finds have all been investigated and have proven to be unreliable. The great "Georgia Marvel" or "Blue Ridge Sapphire," for instance, which was supposed to be a sapphire worth $50,000, turned out to be nothing but a "piece of rolled blue bottle-glass." The paper is interesting as showing just how far we can rely upon our own resources to supply us with ornamental stones. The author also mentions several uses to which domestic material can be applied with fine effect.

BOTANY.[3]

CAN VARIETIES OF APPLES BE DISTINGUISHED BY THEIR FLOWERS.—To a botanist this may seem like a queer question, capable only of an answer in the affirmative, but pomologists have quite universally held to the opposite view. Quotations, like the following, could be made from our most eminent writers of pomological books:

"Peaches are partially classified by the size and color of the petals, but in all the other fruits, as in apples, pears, plums, cherries, etc., the flowers vary but slightly in form and color."

Another says: "Little difference exists in the flowers."

[1] Elemente der Mineralogie. 951 ills., 782 pp., Leipzig, Wilhelm Engelmann.
[2] Washington, Government Printing Office, 1885.
[3] Edited by Professor CHARLES E. BESSEY, Lincoln, Nebraska.

At a meeting of the Michigan State Pomological (now Horticultural) Society, held in 1873, the writer presented a paper on this subject in which he accurately described quite a number of kinds of apples by the flowers.

To the pomologist the term "flower" means the showy petals; to the botanist it means calyx, corolla, stamens and pistils. These floral characters are as constant and reliable for distinguishing varieties as are those characters of the fruit which are usually employed.

In apples the points of the calyx vary in breadth, size and in other particulars. The petals vary in size and shape in different varieties, and some in color. Not very much was made of the stamens, but the styles and stipe furnish excellent characters.

Dr. Hogg, of England, pointed out the value of the shape of the calyx-tube and the position of the stamens on the inside of the tube, but in our American apples, at any rate, these points are not so reliable as are those pertaining to the stipe and styles.

In 1879, at the Rochester meeting of the American Pomological Society, I presented an illustrated paper on the classification of apples, in which the peculiarities of the flowers formed an important part. Many flowers were examined from different trees in various localities. Over a hundred varieties have been examined.

I have since that time frequently called the attention of my students to this subject, and last spring (in 1885) suggested it to one of our graduates, Mr. W. L. Snyder. I have had some of his drawings carefully copied for your use.

Unfortunately in these cases the petals were not drawn, but a glance at the lobes of the calyx, and especially a close examination and comparison of the stipes and styles will show a great difference in the length, breadth, hairiness and other points of the styles.

At the Boston meeting of the American Pomological Society, in 1881, I showed that a similar difference exists in the lobes of the calyx, the shape and size of the petals of pears, but in these flowers the stipe is very short or wanting. The styles vary as do those of apples.

Mr. Snyder also made some notes and drawings of the flowers and inflorescence of some of our cultivated varieties of strawberries. These are quite as marked as those here shown for the flowers of apples.

In case of apples probably 3000 or more varieties have been described by the fruit alone. It is needless to say that with a variety of soils and climates it is next to impossible to define so many in a manner which shall be at all satisfactory.

A similar difficulty exists in our sorts of pears, peaches, plums, grapes, strawberries, raspberries and a myriad of cultivated grains and vegetables; exactly how many I do not know.

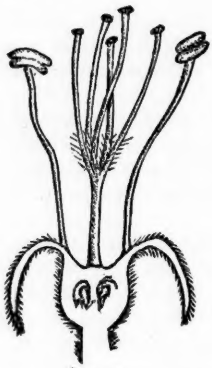


Fig. 1.

Fig. 2.

Fig. 3.

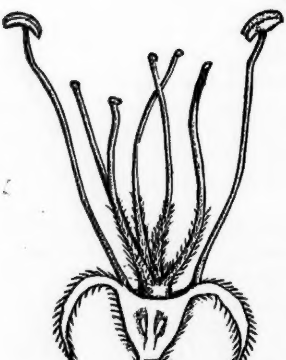


Fig. 4.

Fig. 5.

FIG. 1.—Variety "Red Canada." FIG. 2.—"Talman Sweet." FIG. 3.—"Sweet Bough." FIG. 4.—"Rambo." Fig. 5.—"Wagner." All × 3.

A friend has just sent me 160 named lots of cultivated beans. How are they usually described? Mainly by the time of fruiting, size and color of pod and the peculiarities of the seeds.

We are living in a time when there is much said about the difficulty of describing so many varieties of cultivated plants. It seems to me the correct solution of this problem is here suggested. Instead of describing lettuce and turnips and onions by the shape of leaf and head, color and shape of root, or the color and shape of bulb respectively, let the inflorescence and flowers be carefully examined and a clear record made of *all* the characters which prove to be most reliable. The time has come for more careful work in this direction. The skill of a good botanist should be joined to that of a good horticulturist.—*W. J. Beal, Agricultural College, Mich.*

Formation of Starch in the Leaves of the Vine.—Sig. Cuboni has made a series of observations (Rivista di Viticoltura ed Enologia Italiana, 1885) on the formation of starch in leaves of the vine. In March and April, when the leaves are first formed, starch was never found, even in bright sunshine. It first made its appearance in May, and the quantity increased continually till July. This is not solely dependent on difference in temperature, since starch is still formed in the leaves at the end of October and November; while even in the height of summer the young leaves and shoots are not able to form starch until they are at least a month old. It depends, however, to a certain extent on the maturity of the chlorophyll-grains.

In a leaf containing no starch at the outset, abundance was found after an hour's exposure to the direct action of the sunlight; and the maximum quantity was obtained by two hours' intense sunshine. Four hours of complete darkness is sufficient to cause the whole of the starch to become absorbed.

Although the youngest leaves are unable to form starch, the maximum development is not obtained by the lowest leaves on a branch, but by those on the middlemost nodes; on a branch containing sixteen leaves, by those from the seventh to the eleventh, the lowest showing less than half the maximum power of production.

If an annular incision is made above and below a leaf, separating the elements of the soft bast, the starch in the leaf is not absorbed and transformed in the dark; but if a similar incision is made only below, or only above the leaf, the ordinary process is not disturbed; and this is also the case if a leaf separated by an incision on both sides has a panicle of fruit or flowers opposite it on the same node. No starch is formed if the leaves are etiolated, or attacked by *Peronospora viticola.*— *Jour. Royal Mic. Society.*

The Production of Male and Female Plants.—Recent observations and experiments by Hoffman (Bot. Zeit., 1885) confirm the view hitherto held by some biologists that the production of the male organism is due to insufficient nutrition. In *Lychnis diurna* and *vespertina*, *Valeriana dioica*, *Mercurialis annua*, *Rumex acetosella*, *Spinacia oleracea* and *Cannabis sativa* dense sowing increased the amount of male plants.

Pear Blight Bacteria and the Horticulturists.—Although to the mind trained in the logic of investigation there can be no doubt as to the cause of pear blight, there are yet some horticulturists who do not feel convinced. With them the facts—plain facts—brought out by Mr. Arthur at Ann Arbor, and reproduced in popular form in the December Naturalist, are spoken of as the "Bacterian theory of pear blight," when as a matter of fact there was no "theory" in the presentation. As was remarked by one of the auditors at Ann Arbor, Mr. Arthur's paper amounted to a demonstration, and as a demonstration it must be accepted. One may as well attempt to controvert a demonstration in geometry as to attempt it in this case.

We have observed two principal varieties of denials, and both illustrate the fact that the mind untrained in the methods of scientific reasoning is most incredulous of demonstrations, and most credulous of unproved assertions. (1) It is held on the one hand that the bacteria observed are an *accompaniment* and not the *cause* of the disease, and this in face of the fact that all of Mr. Arthur's investigations were directed to this very point, Professor Burrill having long ago shown the presence of bacteria beyond a doubt. Our horticultural friends must bear in mind that Mr. Arthur's work was not to find whether bacteria *are present* in pear blight. Of that almost any one who has access to a microscope can satisfy himself with but little labor. He undertook the solution of the very matter which is now brought up so calmly, innocently and confidently. And he made no announcement until the demonstration was reached. Let our friends read the testimony candidly and they will be fully satisfied upon this point.

(2) It is held by another class of disbelievers that what Professor Burrill and Mr. Arthur have been working upon is a kind of blight which is quite distinct from the real Simon-Pure blight which works such havoc in the orchards. That is, we have here an attempt to diagnose off-hand, out of sight and hundreds of miles away, the disease to which two trained men gave years of close personal study.

But science is patient, and no doubt the next work of Mr. Arthur will be the study of cases of this so-called other kind of blight. It will then be interesting to know what new line of defense will be set up by those who "do not believe in the bacterian theory of blight."

Botanical News.—Late numbers of the *Botanische Zeitung* contain articles as follows: The pith rays of the Coniferæ, by A.

Kleeberg; The formation and transportation of carbohydrates in foliage leaves, by A. F. W. Schimper; Journal of the fifty-eighth meeting of German naturalists and physicians in Strassburg.——In *Flora* the more important recent articles are lichenological contributions, by Dr. J. Müller; Contributions to our knowledge of the development and the anatomical structure of the fruit-leaves (carpophylls) of Cupressineæ and the placentæ of Abietineæ, by Arno Kramer; and the continuation of H. G. Reichenbach's Comoren Orchids. In Kramer's paper, just referred to, the conclusion is reached that the female cone of the Abietineæ is a single flower and not an inflorescence. The scale is regarded as a placenta, and begins its development as an axillary outgrowth from the axils of a fruit-leaf.——In the *Deutsche botanische Monatsschrift* Paul Richter and Dr. F. Hauck, the well-known German algologist, announce the early appearance of the first fascicles of a distribution of algæ under the title of "Phycotheca Universalis." Each fascicle is to contain fifty numbers, and will be sold for sixteen to eighteen marks ($3.81 to $4.29). Intending subscribers may correspond with Ed. Kummer, the well-known Leipzig bookseller.——In the July-August number of *Hedwigia* Professor Oudemans describes a new species of Puccinia occurring on *Veronica anagallis* in Holland, and to which he gives the name of *Puccinia veronicæ-anagallidis.* It is to be looked for in this country.——The September-October number of the same journal contains a Contribution to the mycologic flora of Missouri, by Dr. G. Winter and C. H. Demetrio. In all 350 species are enumerated, many of which are described as new. Among the latter the most interesting are *Æcidium cerastii* on *Cerastium nutans*, *Diatrype roseola* on dry branches of *Quercus tinctoria*, *Didymosphæria phyllogena* on fallen leaves of *Liriodendron tulipifera*, *Sphærella desmodii* on languishing leaves of *Desmodium canescens*, besides many "Fungi Imperfecti" of the genera Cercospora, Phyllosticta, Septoria, etc.——M. C. Cooke contributes to the December *Grevillea* papers on New British Fungi, Fungi of the Malayan peninsula, *Valsa vitis* again, Synopsis Pyrenomycetum, and British Sphæropsideæ.——The most important paper in the *Journal of Botany* for November is F. N. Williams' Enumeration of the species and varieties of the genus Dianthus. In all 235 species are catalogued, of which nine are described as new to science.——L. H. Bailey's Notes on Carex, in November *Botanical Gazette*, are interesting and helpful.——The December *Journal of Mycology* is devoted to A synopsis of the N. A. species of Dimerosporium and Meliola, by Dr. Geo. Martin; New fungi, by J. B. Ellis and B. M. Everhart; and Index. It is the intention of the managers of this journal to increase its popular interest by a series of sketches of the lives and works of the more noted mycologists. The journal has, as it appears to us, earned a place in botanical literature, and we hope to see it increase its usefulness.

ENTOMOLOGY.

THE PREPARATORY STAGES OF CALOCAMPA CINERITIA (Grote). —One hundred or more eggs were found at Warwick, R. I., clustered together upon a twig of white birch, May 10th, 1885. Diameter of egg $1^{mm.}$ Shaped like a depressed cone, ribbed vertically and dark gray in color. They hatched in the same day that they were found.

Larva upon emergence.—Length 3^{mm}; color, light bluish-green, sprinkled with black. Two pairs of pro-legs only. Head ochreous yellow, large and prominent; two transverse rows of blade tubercles in each segment, each giving rise to a single, simple black hair or bristles. Head likewise provided with black warts and bristles.

After first molt.—Passed the first molt after six days, after which the length of the body was 7^{mm}; uniformly cylindrical and slender. Two front pairs of pro-legs rudimentary. Head less prominent, and green, concolorous with the rest of the body, which is slightly darker than before. Black tubercles disappeared. A single transverse row of minute black bristles in each segment, hardly visible except by the aid of the microscope. These longitudinal dorsal and two lateral lines of very light green. Ventral half of the body of a lighter shade than the dorsal.

After second molt.—Five days later, they began to pass the second molt, after which they measured when extended upon a leaf 12^{mm} in length. Markings same as after the first molt, but more pronounced, dorsal portion of a darker green, and the stripes creamy-white.

After third molt.—After ten days, they passed the third molt. Length 29^{mm}; color, uniform yellowish-green. A pronounced white stripe running the whole length of the body on each side, and above this a much narrower subdorsal stripe on each side of the single dorsal line. Five stripes in all. Dorsal portion of the body sprinkled with white specks. All the pro-legs fully developed.

After fourth molt.—Ten days later, it passed the fourth molt. Length 30^{mm}. Body straight and cylindrical. Head and first segment large and prominent, thicker than the rest of the body. Head rather flat. Color of body below reddish ochreous, head of a lighter shade. A narrow longitudinal white stripe running the entire length of the body, between these stripes a rich yellowish-brown. A dark brown velvety stripe running down the center of the back, with a V-shaped mark of the same color on each segment, with the opening towards the head.

After ten days more without any indication of passing another molt, the larvæ underwent a very decided change. They lost entirely their velvety look, and assumed the greasy appearance of cut-worms, curling themselves up when disturbed, seeking retire-

ment when not feeding, and in all ways taking up the habits of this group of noctuid larvæ.

Being transferred to a cage provided with earth, they at once buried themselves, but came out at night to feed. They continued this life for perhaps a fortnight, when they gradually left off feeding. Just when pupation occurred it was impossible to tell, as the larvæ remained in the ground some time in a torpid state before this change took place, and at this time many of them died.

The pupæ, which had been reserved for description, were unfortunately destroyed by mice. They were of a dark shining brown color, rather thick and blunt at the anal extremity, and somewhat flattened at the thorax. The molts emerged from the 20th to the 30th of September, some two months or more after pupation probably took place.—*Howard L. Clark, Providence, R. I.*

Morphology of Lepidoptera.—In the *Zeitschrift für Wissen. Zoologie* for Oct. 27, N. Cholodkovsky states that it has been found that three species of the Linnæan genus Tinea possess only two Malpighian vessels, a most unexpected phenomenon, and until the present time an isolated fact in insect anatomy, unless we except certain Coccidæ, which have been found by Leydig and Mark to also possess but two Malpighian tubes. On the other hand, Cholodkovsky has found in *Galleria mellonella* Linn. a very peculiar form of Malpighian vessel, which up to now has been described in no other insects, and which only finds its parallel among the Arachnida. This example is an illustration, he says, of the utter incompleteness of our present knowledge of insect anatomy.

In several female *Nematois metallicus* Pod. Cholodskovsky found that each ovary consisted of not less than twelve, and in one case twenty egg-tubes. The number of egg-tubes in Lepidoptera generally is four. There is only a single known exception to this rule. Dr. Alexander Brandt in 1876 discovered that *Psyche helix* possessed on each side six egg-tubes, while Professor Ed. Brandt stated verbally that *Sesia scoliiformis* possesses fourteen egg-tubes.

Cholodkovsky then describes the external and internal genitalia of Nematois, and, in describing the ovipositor, refers to the much more highly organized ovipositor of the common house-moth (*Tineola biselliella*).

All Lepidoptera possess two compound testes, which in the greater number are united by a complicated set of coverings into an unpaired organ. Since each testis consists of four seminal follicles they are in every respect homologous with the egg-tubes of the females. There is anatomically a complete and clear homology between the female and male sexual glands of the Lepidoptera. This fact is not without significance in the morphology of Lepidoptera, especially since it becomes a link connecting the Phry-

ganidæ with the Lepidoptera, though only from forms allied to the Phryganidæ is the phylogenetic derivation of the Lepidoptera conceivable.

He also finds a small chitinous ring at the end of the abdomen of the male, which he regards as the rudiment of a tenth abdominal segment.

Cholodkovsky regards these cases of the occurrence of primitive characters in Lepidoptera as instances of a periodical atavism, or retrogression to the most primitive form of anatomical structure. In conclusion, the author with good reason finds fault with the term "Microlepidoptera," thinking it artificial and absurd to classify animals by their size alone.

Flights of Locusts at San Luis Potosi, Mexico, 1885.—We have received the following description of a flight of locusts at San Luis Potosi, Mexico, in a letter dated June 9, 1885, from Dr. G. Barrœta, well known as one of the most cultivated scientists in Mexico:

"On the 31st May a cloud of grasshoppers came from the N. E. and S. E. to this city, and remained about three hours, leaving only on account of rockets, the ringing of bells and every kind of noise. Never before in this century have locusts invaded this land. By this mail I send a tin box with samples. Those in white paper reached a year ago certain places of the state, 150 miles east of this city, and at the altitude of 3000 feet above the sea. They were collected in Rioverde, aud then the cloud took its way to the southeast. In the aforesaid box, those in blue paper belong to the invading swarm which visited the city on May 31st. I found no difference between them, and suppose them to be the progeny of the swarms noticed in 1884, or, at least, the same species."

Unfortunately the specimens were never received, so that we are unable to give the name of the species.—*A. S. Packard.*

Longevity of Ants.—Not the least interesting fact which has resulted from my observations has been the unexpected longevity of these interesting insects. The general opinion used to be that they lived for a single season, like wasps. Aristotle long ago stated that queen-bees live for six and some even seven years. Bevan, however, observes that "the notions of both ancients and moderns upon the subject have been purely conjectural. Indeed, it appears to be somewhat doubtful whether the length of life which the former seem to have attributed to individual bees was not meant to apply to the existence of each bee-community."

The nests, however, which I have devised have enabled me to throw considerable light on this question. The queen ants are so easily distinguished from the workers that they can be at once identified, while, if a nest be taken in which there is no queen, we can satisfy ourselves as to the workers; because, though it is true

that workers do sometimes lay eggs, those eggs invariably produce male ants. Hence, in such a case, the duration of the nest gives us the age of the workers; at least they cannot be younger, though, of course, they may be older. In this way I have kept workers of *Lasius niger* and *Formica fusca* for more than seven years. But, what is more remarkable still, I have now two queens of the latter species which I have kept ever since 1874, and which, as they were then full-grown, must be now nearly twelve years old. They laid fertile eggs again this year, a fact the interest of which physiologists will recognize. Although a little stiff in the joints, and less active than they once were, they are still strong and well, and I hope I may still keep them in health for some time to come.—*Sir John Lubbock in Contemporary Review for Nov.*

Entomological News.—In the Proceedings of the Entomological Society of Belgium, Dec. 5., the venerable Senator M. de Selys-Longchamps gives the outlines of a revision of the Agrionines.——The *Zeitschrift für Wissen. Zoölogie*, October 27, contains an elaborate article on the anatomy of the Mallophaga, by F. Grosse; it gives excellent figures of the mouth parts.——Mr. L. Bruner publishes in the Bulletin of the Washburn College laboratory of natural history a "first contribution to a knowledge of the Orthoptera of Kansas," with descriptions of a number of new species.——In the same publication, Mr. F. W. Cragin notices certain Myriopods and Arachnids of Kansas.——In the Memoirs of the National Academy of Sciences, Mr. S. H. Scudder describes and figures a Tertiary Orthopod; it has no distinct head. It is referred to the Thysanurans, and regarded as the type of a suborder called Ballostoma. We would add, that the thysanurous characters do not seem to be well marked, while it is possible that the specimens, though numerous, had lost their heads.——In Dr. Agassiz' report as curator of the Museum of Comparative Zoölogy, it is stated that the museum has received from the Peabody Academy of Science at Salem the most important collection of insects ever added to the museum. It contains a large number of types described by prominent American and European entomologists. The collection, we may add, was brought together mainly by Professor A. S. Packard. It contains a large proportion of Packard's types, including those of his monograph of geometrid moths, of which only four species are wanting, and nine described by him from specimens belonging to other entomologists. It also comprises types of Mr. Grote and the late V. T. Chambers, as well as types of Zeller, Staudinger, Foerster, Walker, etc.

ZOÖLOGY.

Antidote to the Scorpion's Sting.—Already an antidote has been discovered to the sting of scorpions, which, although rarely fatal, is extremely painful, while the poison is closely allied to that of the venomous snakes. Mr. A. M. Markham, of the Indian Civil Service, has written to one of the Indian papers calling attention to the fact that the root of *Achyranthes aspera*, known popularly as *chirchirra*, affords almost instantaneous relief from the pain caused by the sting of a scorpion. The plant is very common everywhere in India, and is one of those whose clinging burrs are such a nuisance on one's legs when out shooting. The root, macerated in water, is applied to the part stung, and a small quantity is drunk in water. If this be done quickly, there is absolutely no pain half an hour or so after the sting, instead of the twelve to twenty-four hours of intense suffering which follow an untreated sting.—*London Standard.*

The Crustacea of the Black Sea.—Mr. Waldemar Czerniawsky, already known for his works on the fauna of the Black sea, has now published at Charkoff, a work on the "Crustacea decapoda Pontica littoralia," accompanied by several plates, being a very elaborate description of the Black Sea Decapods. The number of Pontic species of Decapods has been increased by twenty, reaching thus forty-eight species, with numerous varieties, though it will probably be greater when the depths of the Black sea have been better explored. The results of this work are numerous and interesting. The species offer altogether a very great variety of forms. The Black sea contains the local forms of Mediterranean varieties, while in the Celtic region are found the local forms of other varieties. The author asserts that the metamorphosis of the superior crabs, such as Carcinus, which presents nine different stages, are a repetition of their genealogy, and arrives at a series of very interesting conclusions as to the genealogy of different species. All three species of Astacus which are found in the Ponto-Caspian fauna are maritime forms which have immigrated into sweet water, and even the *Astacus pachypus* Rathke, of the mountain-like Abran, is a remainder of a maritime fauna; so also Thelphuca, which has gigantic representatives in the South Caspian. Certain crabs reach really gigantic size in the Ponto-Caspian region, such as *Eriphia spinifrons* and *Carcinus mœnas* on the shores of Crimea and at Odessa. While most crabs reach a great development only in very salt and warm water, others reach the same size under the influence of reverse conditions. The Decapods of the Azof sea have not yet been explored. The descriptions of the species and their varieties being given in Latin, as also the explanations to the plates, the work is rendered accessible to all zoölogists, many of whom however, will regret not to be able to understand the notes (mostly zoö-topographical and sometimes adding minor details to the description), which are in Russian.—*Nature, March 5, 1885.*

THE MOLTING OF THE LOBSTER.—During the past season I have been able to make some observations on the mode of molting of the lobster. In Casco bay, Maine, the lobster molted during the second and third week of July. According to the lobster-fishermen, the creature molts but once a year, and as confirmatory of this the lobsters we saw were in several cases covered with patches of polyzoans, with large barnacles, mussels, etc., which could not have been of the present year's growth.

Shortly before the animal molts the parts between the segments are much swollen, and have a livid color. Meanwhile the inner side of the flattened basal joints (3–5) of the large claws become soft, the lime on the crust partly disappearing, leaving an irregular oval solid portion; in this way the contents of the large hand or claw can be drawn through the basal portion of the limb. The first step in the ecdysis is the splitting or partial separation of the two halves of the carapace; it may entirely separate posteriorly, or the two halves remain together, and the animal withdraws its body out of the sutures between the thorax and first abdominal segment. The integument of the legs is molted last, and when owing to rough handling, the process is delayed, the extremities of the legs slough off. The entire integument, with all the appendages of the head, thorax, and the abdomen are molted as a whole, but the abdominal legs are molted before the thoracic ones. I have found all the parts of the crust connected, and floating in the "lobster car," even including the lining of the proventricle or stomach, and the apodemes of the head and thorax. After the molt the soft and flabby lobster lies nearly motionless, occasionally, if disturbed, giving a flap with its "tail." It remains inactive for nearly or quite a week, until the new crust becomes hard.

I am convinced from my observations that the deformities in the big claws as well as other parts occur at the time of molting; as after disturbing the symmetry of the claws in our specimen, the deformity persisted.—*A. S. Packard.*

THE OLDEST TARSUS (Archegosaurus).—The Neues Jahrbuch für Mineralogie, Jahrgang 1861, pp. 294–300, contains a paper by Professor Quenstedt, of Tübingen: "Bemerkungen zum Archegosaurus." On Plate III, connected with that article, a nearly entire hind-foot of Archegosaurus is figured (fig. 6). The tarsals of this foot are preserved in their original position, and it is of very high interest; but, strange to say, this figure of Archegosaurus has been entirely overlooked, and is never mentioned in any paper relating to the tarsus of vertebrates.

Professor Quenstedt believes that there are ten or twelve tarsal bones preserved. The question now is, What are the homologies of these bones?

On the whole, the hind-foot recalls very much that of Cryptobranchus and Menopoma. One or perhaps two bones are con-

nected with the tibia; if there is only one, this must be the tibiale. Two elements are attached to the fibula—the intermedium and the fibulare. Four metatarsals are preserved, but it is possible that there were five. Each of the four metatarsals is supported by one tarsal bone. Between the four bones of the distal series and those of the proximal one there are to be seen *four* additional bones. The inner one I consider the tarsale$_1$, belonging to the first digit not preserved. The remaining three bones must be considered as three central bones.

If two bones are connected with the tibia, the outer one represents the tibiale, the other one a centrale, reaching the tibia in the same way as in Salamandrella (Wiedersheim). In this case, we have four central bones. Between the fibulare and tarsale$_5$ there is a large space without any bones. There is little doubt, I think, that there existed a sixth tarsal bone in the distal series, as in Cryptobranchus, remaining cartilaginous, and therefore not preserved.

Wiedersheim[1] described three central bones in the tarsus of the Axolotl; fig. 8, pl. XXX, comes nearest to the condition in Archegosaurus.

There are two explanations of the morphology of the tarsus in Archegosaurus, if there are five digits:

1. Tibiale, intermedium, fibulare; centrale$_1$, centrale$_2$, centrale$_3$; tars.$_1$, tars.$_2$, tars.$_3$, tars.$_4$, tars.$_5$, tars.$_6$.

2. Tibiale, intermedium, fibulare; centrale$_1$, centrale$_2$, centrale$_3$, centrale$_4$; tars.$_1$, tars.$_2$, tars.$_3$, tars.$_4$, tars.$_5$, tars.$_6$.

Archegosaurus belongs to the Rhachitomi, the oldest batrachians known. *The presence of certainly three, perhaps four central bones, is a new proof for the correctness of the position given to this group by Professor Cope.—Dr. G. Baur, Yale College Mus., New Haven, Conn., Dec. 17, 1885.*

THE INTERCENTRUM OF LIVING REPTILIA.—The Pelycosauria of the Permian formations possess intercentra in the dorsal, lumbar and sacral regions. In no living reptile have intercentra been described, so far as I know, in that part of the column, excepting in Sphenodon (Hatteria).[2] I find them also in *Gecko verticillatus* Laur. (*G. verus* Gray). In these forms intercentra are developed between *all* vertebræ.

It is probable that the same elements will be found in the other Geckonidæ and in the amphicœlian Uroplates, the only genus of the family Uroplatidæ.

Lumbar intercentra in the Mammalia are first mentioned by Owen[3] in the mole. Meyer[4] finds these elements also in the pos-

[1] Wiedersheim R. Ueber die Vermehrung des Os centrale im Carpus und Tarsus des Axolotls. Morph. Jahrb., Bd. VI, 1880, pp. 581–583, pl. XXX.

[2] See Albrecht, Bull. Mus. Roy. Hist. Nat. Belgium, 1883, p. 190.

[3] Owen, R. On the cervical and lumbar vertebræ of the mole (*Talpa europæa* L.). Brit. Assoc. Rep., 1861, pp. 152–154. London, 1862.

[4] Meyer, O. Insectivoren und Galeopithecus geologisch alte Formen. Neues Jahrb. für Min., 1885, Bd. II, pp. 229–230.

terior dorsals and the sacrals, and I can confirm his observations. —*Dr. G. Baur, Yale College Mus., New Haven, Conn., Dec. 19, 1885.*

The Intercentrum in Sphenodon.[1]—Researches into the embryology of the Urodela and Anura have not yet brought to light any traces of the rhachitomous structure; a condition of things which is probably due to cœnogeny or falsification of the embryonic record—a phenomenon which is not uncommon. There can be no doubt, however, that the entire record was presented in the embryonic history of Permian land Vertebrata, and for a long period subsequently, but that the rhachitomous stage has been, *with the true centrum*, lost from the batrachian line at least. The only existing reptile which could be expected to show important traces of the ancestral, or embolomerous stage, is Sphenodon. This genus, as is well known, is the living representative of the order Rhynchocephalia, the nearest order to the Theromorpha. Having fortunately a specimen in alcohol, presented to me by Dr. Hector, the able director of the Geological Survey of New Zealand, I examined the caudal vertebræ to determine the connections of the chevron bones. I find these to be attached, not principally to the centra, but to a cartilaginous disciform intercentrum, closely resembling that of Cricotus.[2] The intercentrum has so much the form, including the rounded superior surface and the foramen chordæ dorsalis, of that of the Permian genus of Batrachia, as to impress on me still more strongly the probability of the Embolomeri being the batrachian type which is ancestral to the Reptilia. An illustrated memoir on this subject is at present in press.

The centra differ much from those of Cricotus in their form, resembling in outline those of the Pelycosauria. They however have the vertical median partial suture seen also in the Lacertilia, as already described by Günther. The caudal vertebræ are so gradually modified as we followed them forwards, however, as to make it probable that these halves do not represent any of the elements of the rhachitomous column besides the true centrum.

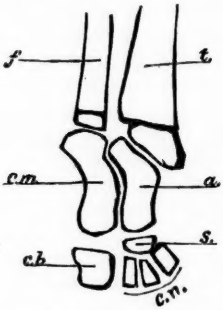
I add that there is probably a hypocentrum pleurale in the cervical region of the rhachitomous Eryops. They become ossified early with the posterior side of the intercentrum in front of them.—*E. D. Cope.*

On the Tarsus of Bats.—In the course of some recent observations made upon the tarsus of bats, I ascertained that the astragalus and calcaneum were elongate, and exhibited the general characters of these bones in mammals in which little or no weight

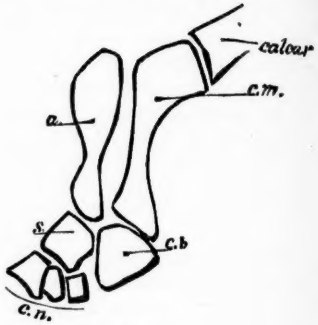
[1] On the Batrachian Intercentrum, Naturalist, 1866, p. 76.

[2] Since the above was written, Vol. II, pt. II, of Fritsch's Fauna der Gaskohle has come to hand. It contains a note on the intercentra of Sphenodon.

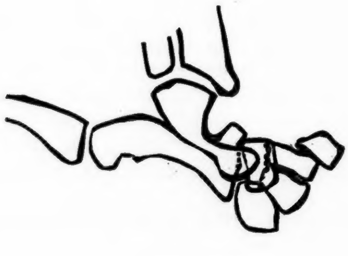
is borne upon the posterior extremities. Both bones were so disposed that the larger end of each is directed proximally. The general form was that of a metatarsal element, with the exception of the body or shaft, which was notably narrowed. In



Rhinolophus capensis (young).



Carollia.



Chilonycteris.

Rhynchonycteris.

Vespertilio subulatus.

Atalapha novæboracensis.

f, fibula; *t*, tibia; *cm*, calcaneum; *a*, astragalus; *s*, scaphoid; *cb*, cuboid; *cn*, cuneiforms; *so*, supernumerary ossicle.

Rhinolophus the calcaneum entered into the ankle joint. In the other forms examined the calcaneum was independent of the

joint. In the Phyllostomidæ (as well as in Natalus and Rhynchonycteris) the calcar of the calcaneum was placed in axial line with that of the bone last named. In other families the calcar was adjoined to the calcaneum at the outer side and near the proximal end. The astragalus and calcaneum were nearly of the same size in most forms, the calcaneum being the larger. In the aberrant form Rhynchonycteris the astragalus was nearly twice the length of the calcaneum. I have appended a few diagrammatic sketches of the tarsus.

The method employed in studying the tarsus consisted in removing all the soft parts of the foot, immersing in absolute alcohol, transferring to oil of cloves and mounting on a glass slide. A low power of the microscope resolves all the essential structures. —*Harrison Allen.*

Range of the American Bison.—Late issues of the St. Paul *Pioneer Press* report: "Reliable cowboys just arrived in Miles City, Mont., report that at the Lower Musselshell round-up they saw a fresh trail of about 100 buffalo on the head of the Big Porcupine last week, and had seen twelve head a few days before. They killed one out of the twelve. The number of wild animals on the North Yellowstone ranges have proved not only a source of annoyance to herd owners, but also of great damage to these newly stocked ranges. Round-up parties, in scouring those districts this spring, complain of the great number of calves killed and crippled by wolves and other wild animals. On Custer creek calves were found that suffered from torn and bitten backs, which the boys attributed to the attacks of wildcats. Had the calves been hamstrung the work would have been charged to wolves instead of wildcats. The loss from the above source is probably greater than most people would imagine." "The Maginnis boys met on their last trip probably the last remnant of the mighty herds of bison that once roamed over these plains. About 200 wanderers were encountered in Flatwillow Creek bottoms, and for a time the round-up lived on succulent, juicy buffalo humps instead of choice Montana beef."—*Forest and Stream.*

Zoological News.—*Invertebrata.*—Professor H. Carpenter, reviewing the arguments of the French naturalists against, and of the German in favor of, the separateness of the blood-system and water vacuum system in echinoderms, states his belief in their separateness. Ludwig's observations have as yet not been disproved, as no one has ascertained that the blood-vascular system communicates with the exterior through the madreporite.—— Five new Bulimini from the Levant have been described by Dr. O. Bœttger (P. Z. S., 1835, 23).——The ninth part of the description by the late T. G. Jeffreys, of the Mollusca of the *Lightning* and *Porcupine* expeditions contains the Yanthinidæ, Naticidæ, Neritidæ, Solanidæ, Xenophoridæ, Velutinidæ, Cancellariadæ,

Aporrhaidæ, Cerithiidæ, and Cerithiopsidæ, seventy-five species in all.——The worm *Gordius verrucosus*, obtained by Mr. Johnston on Kilimanjaro, is found also in South Africa, Ceylon and Central America.——A river-crab from Kilimanjaro is by Mr. E. J. Miers referred, with some hesitation, to *Thelphusa depressa.*

Batrachia and Reptilia.—Mr. W. B. Spencer contributes (Quart. Jour. Mic. Soc., 1885) some notes on the early development of *Rana temporaria*, with especial reference to the fate of the blastopore, and the development of the cranial nerves, which seems to be a more ancestral process than the method of their development in Elasmobranchs and birds.——G. A. Boulenger describes (P. Z. S., 1885, 22) a new species of frog, *Rana macronemis*, from Asia Minor. Its nearest ally is *R. temporaria.*——*Lepidosternon polystegum* is a Brazilian amphisbænoid with a sharp-edged cutting snout and singular scutellation of the top of the head. By means of its snout it has been known to cut its way through the side of a coral snake which had swallowed it.

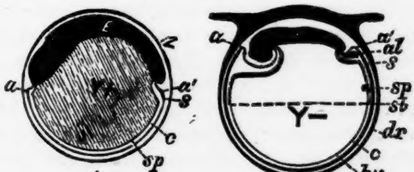
Birds.—Mr. T. H. Guillemard (Proc. Zoöl. Soc. Lon. 1885), gives a provisional list of the birds known to inhabit the Sulu archipelago. These are sixty-five in all, including sixteen previously listed by Mr. Sharpe. If birds of wide distribution are deducted, thirty-nine species are left, out of which thirty are formed in the Phillipines.——Professor W. Watson has contributed to the Proc. Zoöl. Soc. London some interesting notes on Peruvian birds. He has rediscovered the cliff-swallow, *Petrochelidon ruficollis* Peale. This bird was long searched for in the Andean valleys, and was ultimately found close to Lima. The nest is always found on human habitations. *Psittacula andicola* is a parrot which is peculiar to the higher parts of the western valleys of Peru, and occurs in the valley of the Rimac wherever vegetation is on the mountain sides. *Cypselus andicola* inhabits the western valleys of the Peruvian Andes from 6000 to 13,000 feet. The birds brought by Mr. H. H. Johnston from Kilimanjaro include fifty species, of which six, *Muscicapa johnstoni, Pinarochroa hypospadia, Pratincola axillaris, Nectarinea johnstoni* and *kikimensis* and *Cinniris mediocris*, are new to science. The second of these occurs at a height of 14,000 feet; the third at 10,000; the fourth at 11,000, and the last at 12,000. Few of the remaining species reach these great elevations, but *Palumbus arquatrix*, attains 10,300 feet, and *Corvultur albicollis* reaches up to the snow-line.——Mr. F. E. Beddard divides the Cuculidæ into Cuculinæ, with the genera Cuculus, Chrysococcyx, Cacomantis, and Coccystes? from the Old World, and Saurothera, Diplopterus, Piaya and Coccyzus from the New; Phenicophainæ, with the Old World genera, Phenicophæs and Endynamis; and Centropodinæ, with Pyrrhocentor, Centropus and Coua from the Old World, and Geococcyx, Crotophaga aud Guira, from the New.

Mammals.—Mr. Sidebotham (Proc. Zoöl. Soc. London, 1885) gives a detailed account of the myology of the water opossum, *Chironectes variegatus.*——The discovery of the wild cat (*Felis catus*) in Ireland, is often reported, but investigation has always shown that the supposed wild cat was but a feral specimen of the domestic cat.——A leopard skin in which most of the rosettes are replaced by black spots, numerous and of small size, has been brought from South Africa, and is the first African species which exhibits the tendency to melanism so strongly developed in some Asiatic individuals.——Mr. O. Thomas (P. Z. S. 1885, 329), distinguishes three varieties of the echidna, viz: *E. lawesi, aculeata* and *setosa.* The only remaining recent species of the family is *Taglossa bruijni,* a larger animal, found in Northwestern New Guinea.——A new species of paca (*Cælogenys taczonowski*) is described by Sulzmann, who obtained it in Western Ecuador, where it inhabits mountains between 6000 and 10,000 feet above the sea. Like the well-known paca, it digs a burrow with two openings. The native name is Sacha-cui.

EMBRYOLOGY.[1]

The Origin of the Amnion.—The purpose of the present note is to point out some of the mechanical conditions and causes which have been competent, in the course of the *development of development,* to bring about the formation of the amnion. No embryological writer, as far as I am aware, has ever attempted to trace the amnion to the part in the embryos of anamniated forms which led up to its development in the amniated ones. Balfour said, that "it does not seem possible to derive it from any pre-existing organ" (Comp. Embryol., II, 256). And he says further (op. cit., 257): "The main difficulty is the early development of the head-fold of the amnion." Balfour's view, that it is developed *pari passu* with the outgrowth of the allantois, is utterly inadequate to explain the genesis of the amnion of insects or that of *Peripatus edwardsii* and *P. torquatus,* for in them no allantois is formed. His hypothesis also breaks down in the light of the brilliant researches of Selenka on the inversion of the layers in the Rodentia.

A comparison of the longitudinal, vertical, diagrammatic sections, figures *A* and *B,* of an osseous fish-egg and a mammalian ovum respectively, will conclusively show that the somatopleure *s,* in *A,* is the exact homologue of the layer giving rise to the amniotic folds in *B,* though in *A* this layer merely covers the space



A B

[1] Edited by John A. Ryder, Smithsonian Institution, Washington, D. C.

between the yolk y and the somatopleure, leaving the cœlomic space c, which has been derived directly in the osseous fish embryo from the cleavage cavity of the egg. We thus find that the preëxisting structure, from which the amniotic folds are formed in the higher types, is already present in the embryos of osseous fishes. The next important point to demonstrate is, at what grade in the phylum of the Chordata traces of amniotic folds first appear, and whether such rudiments of an amnion are also found in the embryos of osseous fishes.

Glancing at A, it will be seen that there are rudimentary amniotic head and tail folds developed at a and a', and that we, therefore, have traces of an amnion appearing for the first time in embryos of the grade of osseous fishes. This is not universal, however, for it is found that in species in which the zona radiata z does not closely invest the ovum, the embryo E is not pressed down into the vitellus, so as to raise the somatopleure s into a fold or duplicature around the ends and along the sides of the embryo. The zona invests the ovum more or less closely in almost all Teleosts, but in a few, Alosa, for example, it does not, and in this species no traces of amniotic folds are ever developed.

The embryo is differently conditioned in those eggs with the zona fitting closely around the ovum from those in which there is a great space around the egg, and between the latter and the zona. The inference, therefore, is that in the first case the embryo E is pressed down mechanically into the yolk by the presence externally of the rigid zona. As the embryo E grows, and the yolk substance of the ovum is converted into it, the latter is replaced in the space within the zona by the embryo. It is thus rendered evident, that, in those types of teleostean ova with a closely fitting zona, the rudimentary amniotic folds which are formed around the embryo have been mechanically caused by the rigid zona in the presence of the active forces of growth. If we examine the mechanical conditions under which the eggs of still higher forms are placed, we will find the same reasoning to hold. We are thus, it seems, obliged to conclude that the amnion in all forms has arisen in consequence of the forces of growth resident in the embryo, encountering peripheral and external resistance either in the form of a rigid outer egg-shell, zona radiata z, or decidua reflexa dr, or even the walls of the uterine cavity itself, supposing, of course, that a large vesicular blastoderm containing yolk has been formed by epiboly.

The gap between the truly epicyemate embryo, as seen in Alosa, and the endocyemate embryo of the Paratheria and Eutheria is, therefore, partly bridged by the presence of a rudimentary amnion, or amniotic folds in many teleostean embryos just prior to their escape from the eggs, or where the zona is ruptured. When this occurs the amniotic folds vanish, as in the embryos of many of the Salmonidæ, for example, and a closed amni-

otic sack is never formed, because, in the first place, the intra-oval period of development does not last long enough; nor, in the second place, is it possible, owing to the comparative small size of the yolk, and the rapid growth of the embryo, for the latter to become bodily invaginated into the blastodermic vesicle, which is filled with yolk. The amniotic folds can, therefore, not meet upon the middle line of the back, and coalesce, as they do in the higher endocyemate forms. The development of a transient amniotic head-fold of greater width and in advance of the side and tail folds, is also prevented by the absence of a strongly marked cranial flexure in the embryos of Teleosts.

The mechanical effect of the gradual development of the cranial flexure in exaggerating the development of the amniotic head-fold in the Chordata, will be best appreciated by a glance at diagrams I, II, III, and IV, representing respectively the brain of an acraniate, a marsipobranch, an elasmobranch and a mammal. With the increase in the volume and area of the cerebral cortex, which occurs mainly on the dorsal and lateral aspects of the anterior end of the neurula, the acceleration of growth of the brain substance also occurs on those aspects, and a downward flexure of the floor of the brain necessarily takes place. The rapid enlargement of the cephalic end of the embryo of an endocyemate, eutherian or paratherian form, and the rapid or precocious development of the cranial flexure, would naturally, in such a type, tend to cause the amniotic head-fold to be developed earlier and to a greater extent than the tail-fold, as is shown in Fig. *B*, at *a*.

In the eutherian types, with inverted germinal layers, an amniotic head-fold of the kind developed in normal forms is never formed, because the cavity of the true amnion in the former is developed by the vacuolization or the formation of a cavity or cavities in the solid epiblastic mass, and not by invagination. In the Tracheates possessing an amnion there is no cephalic flexure, and the part of the amnion which is first developed in the most pronounced manner is often the tail-fold, due apparently to the ingrowth of the caudal end of the embryo into an involution of the blastoderm, confined in a rigid egg-envelope, the involution being thrust into the yolk. Later, with the growth and encroachment of the head-end of the embryo upon the yolk, the abdomen is again everted in some cases from its amniotic sack. In *Peripatus edwardsii*, according to Von Kennel, cleavage is total, the development is viviparous and intra-uterine, a hollow blastula is formed, the embryonic area at one pole of the blastula is invaginated into the latter, so that the ventral surface of the embryo is

directed towards the roof of the amniotic cavity, the reverse of the eutherian embryo. An umbilical stalk is also formed, which springs from the dorsal surface of the embryo and passes to a partially zonary placenta, disposed in relation to the uterine walls in exactly the same way as that seen in the embryo of Carnivora. If we now regard the dorsal surface of the embryo of *Peripatus edwardsii* as homologous with the ventral surface of the embryos of Carnivora, the resemblance between the modes of development of these two types becomes still more startling. While it is manifestly absurd to even attempt to suppose, on the strength of these resemblances, that there could be any genetic affiliation between the Carnivora and Malacopoda, the only way out of the difficulty seems to be to suppose that the similar methods of development of the two arose in response to the similar conditions which environ the ovum during its early stages of growth.

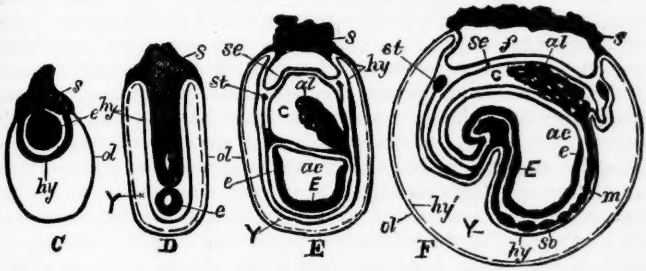
The differences between Von Kennel and Sedgwick, as to the modes of development of *P. edwardsii* and *P. capensis*, it seems to me, may be readily understood and reconciled when it is considered that the first is holoblastic and endocyemate, while in the latter the egg is meroblastic, and apparently undergoes an epicyemate process of development.

All the data in the foregoing paragraphs unequivocally support the thesis that the amnion has been developed mainly by mechanical means and conditions.

The rigid zona of the epicyemate teleostean embryo, as shown in Fig. *A*, in which the yolk *y* is a positive quantity, is represented by the maternal envelope *dr* in Fig. *B*, in which the yolk, as such, is absent. The gap between the condition of *A* and that of the types with apparently inverted germinal layers, so completely elucidated by Selenka, is a wide one; yet it seems easy to pass from the primitive condition of *A* to that of the extremest form, viz, the guinea-pig; if the rabbit, mole (Heape), the vole (Kupffer), and the mouse and rat (Selenka), are considered as intermediary steps. So complete or extreme has been the invagination of the embryonic mass or area in these forms that, in the extremest type, the embryo is finally developed at that side or pole of the primitive blastula which is exactly opposite the point where the blastodisk was originally formed, as in normal Eutheria. The way in which this is accomplished is quite remarkable, and may now be described, as the process is a special modification of that by means of which the usual endocyemate condition is brought about.

Selenka finds that there is an outer layer of cells, *ol*, Fig. *C*, split off from the ectoblast, as first described by Rauber, in the rabbit's ovum, and which take no direct part in the formation of the embryo. He also finds that upon the further growth of the ovum, after the blastula stage is reached and the germinal area or disk is developed, the blastula rapidly elongates in the direc-

tion of the diameter extending from the centre of the blastodisk to the opposite pole. By this time the blastula has become



adherent to the uterine epithelium through the intermediation of the transitory outer layer of cells, *ol* (*Reichert'sche Deckschicht*), already mentioned, but the constituent cells of a certain portion of this outer layer, just overlying the germinal disk, as indicated at *s*, rapidly proliferate, so as to form a lenticular or columnar thickening or mass, constituting what Selenka calls the *Träger*, a term which may be anglicized by the word *suspensor*. This suspensor immediately overlies and pushes the germinal area or mass inwards before it, down into the hollow cavity of the blastula. The germinal area is either pressed inwards into the hollow blastula, so that it assumes a concave form above, with a cavity between it and the lower surface of the suspensor, as in Arvicola, or the epiblast forms a solid mass, before which the hypoblast is pushed inwards by the ingrowth of the suspensor, so that the blastula assumes the form of an elongated sack, as in the ovum of the rat or the guinea-pig.

The process just described is somewhat similar to that of gastrulation, for the germinal pole of the blastula is pushed downward into the sack formed by the hypoblast and outer layer, so that the embryo is finally developed quite at the opposite pole of the elongated blastula, as in the guinea-pig. The steps by which the mode of development of the embryo of the latter came to be established will be much better understood by reference to diagrams *C*, *D*, *E*, and *F*, representing four stages of the development of the rat copied from Selenka.[1] In these figures it will be obvious to the reader that the principal result of the precocious invagination of the embryonic area is to throw the embryo to the opposite pole of the egg, and to so encroach upon the cavity of the mesenteron, the umbilical vesicle, as to almost obliterate it, as is shown in Fig. *F*. The embryo *E* is also bent into a curve, just the reverse of that shown in Fig. *B*. The cœlomic space *c* is also more restricted, and the sinus terminalis *st*, in Fig. *F*, seems to

[1] Studien über Entwickelungsgeschichte der Thiere. Drittes Heft. Die Blätterumkehrung im Ei der Nagethiere, 4to. Wiesbaden, Kreidel, 1884.

terminate towards the dorsal pole of the ovum instead of the ventral, as in Fig. *B*.

In the ovum of the guinea-pig the obliteration of the umbilical vesicle *y* is carried still farther than in Fig. *F*, because the hypoblastic layer *hy'*, next to the layer *ol*, is absent, and the hypoblast lying just under the embryo is brought into immediate contact with the layer *ol*, thus giving rise to the illusion that a complete inversion of the primary embryonic layers has occurred. I say illusion, because there has been no actual inversion of the primary layers, for the latter have been merely shoved to the opposite pole of the eggs into contact with the layer *ol*, where embryonic development has proceeded in the normal way, being modified only by the displacement which the germinal area has suffered in relation to the other essential parts of the ovum. It is as if the germinal pole of the blastodermic vesicle had become concave instead of convex, and collapsed inwards against the inside of its lower pole, the walls of which consist of the hypoblast of the inferior pole of the umbilical vesicle—mesenteron, and the outer layer.

The difficulties which Balfour speaks of have, I hope, been satisfactorily cleared away by what has been said above, and a rational and connected hypothesis as to the genesis of the amnion firmly established. I am aware that many objections may be urged against the views here propounded, but I cannot think that any other view of the case will so satisfactorily reconcile and coördinate the facts involved. To those who take a philosophical view of such subjects, it will be obvious that the deductions here reached give but little countenance to the idea that amniotic characters can be always profitably used in taxonomy, at least, not until the forces which have led to their development are better understood. On the theory of the development of development, the extreme modification of the amnion of some of the Rodentia would cause the latter to take higher rank than the Primates, because, as shown in Fig. *F*, the primary amniotic cavity becomes divided, and a relatively large false amniotic cavity *f* remains just under the suspensor *s*, and shut off from the true amniotic cavity *ac* by the intervening serous envelope *se*, the cœlomic space *c*, and the somatopleural roof of *ac*. Such reasoning, however, is obviously not legitimate in the light of the above mechanical hypothesis of the genesis of the amnion.

To briefly summarize, we find that the first traces of amniotic folds met with in the embryos of the lower types of Chordata are caused by the resistance from without offered to the growth of the embryo by a rigid zona radiata. In such types the amniotic folds are transitory, and disappear at the time the zona is ruptured. After a larger yolk has been acquired the embryo undergoes a longer period of intra-oval development, so that the period of the persistence of the amniotic folds, produced as before, is prolonged.

With the increase in the size of the embryo, in these large-yolked forms, it is finally thrust down into a saccular involution of the blastoderm, the lips of the opening of which meet over the back of the embryo where they coalesce, the outer limb of the duplicature giving rise eventually to the serous envelope, and the inner to the roof of the amniotic cavity. In those types which have the primary layers apparently inverted, the rapid ingrowth of the suspensor precociously invaginates the germinal area inwards before the embryo is distinctly developed, so that it is not formed in its usual or normal position. These extreme modifications were not possible until after the loss of the food-yolk, after which a hollow blastodermic vesicle still continued to develop, filled with a thin albuminous or serous fluid instead of a dense yolk material. The tendency of the eutherian ovum to form a large, hollow blastodermic vesicle or blastula is doubtless an inheritance transmitted from a paratherian source. The bodily invagination of the whole embryo, and the more or less complete obliteration of the cavity of the umbilical vesicle by the rapid growth of the enlarging amnion, would be readily accomplished in the course of the development of the eutherian ovum.

EXPLANATIONS OF THE REFERENCE LETTERS USED IN THE FIGURES.

a amniotic head-fold, *a'* tail-fold, *ac* amniotic cavity, *al* allantois, *c* cœlomic space or continuation of body cavity, *dr* decidua reflexa of uterus, *E* embryo, *e* epiblast, *f* cavity of false amnion (*falsche amnionhöhle*), *hy* hypoblast, *hy'* hypoblastic outer wall of umbilical vesicle, *m* mesoblast, *ol* outer layer (*Reichert'sche Deckzellen, Deckschicht*), *s* suspensor (*Träger*), *se* serous envelope, *so* muscular somites, *sp* splanchnopleure (= the periblast in Fig. *A*), *st* sinus terminalis, *Y* yo.k, with + and — signs to indicate its presence or absence.

—*John A. Ryder.*

DECEMBER 31, 1885.

PHYSIOLOGY.[1]

THE EXISTENCE OF TWO KINDS OF SENSIBILITY TOWARD LIGHT. —MM. Charpentier and Parinaud, working independently, have concluded that visual sensations involve two distinct kinds of physiological processes. Sensations of one kind are "photesthetic" and involve luminous sensations pure and simple, merely discriminating light in distinction to darkness. The other sensations are truly "visual" and are necessary to the perception of color, of form, and to distinctness of vision. The first kind of sensation is supplied by the excitement of the rods of the retina through the chemical disintegration of the "visual purple," which is found in their outer segments. The power of giving rise to the second kind of sensations is confined to the retinal cones which wholly compose the bacillary layer of the fovea centralis, but which relatively decrease in number with reference to the rods as we recede from this area. Parinaud declares that the increase of sensibility of the retina to small differences of luminosity when the amount of objective light is extremely small is confined

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

to the area outside the fovea centralis. This increase of sensibility is proportionately greater toward the more refrangible rays. This fact affects the tone of colors, and on account of it the luminosity of (the more refrangible ?) colors is increased at the expense of their saturation. The reader may be reminded, as an interesting confirmation of this view that, when alternate circles, painted blue and red, are looked at in obscurity, the former appear luminous and the latter black. Visual purple is bleached by light and is regenerated under the influence of the pigmentary layer of the retina in the dark. In these facts we have an explanation of the varied sensibility toward light of different intensities.—*Comptes Rendus, 1885, p. 821.*

The Circulation in Ganglion Cells.—A most curious discovery, if it be confirmed, is that announced by Adamkiewicz concerning the supply of blood to nerve ganglion cells. In his researches on the blood-vessels of the spinal cord, the author found that the richness in capillaries was directly proportional to the number of nerve-cells. His more special investigations of this relation were made on the intervertebral ganglia taken from injected animals. The nerve-cells composing these ganglia are each inclosed in a connective-tissue capsule, lined by flattened cells and having two tubular prolongations from it. The nerve-cell itself is inclosed in a special sac of flattened cells and possesses two prolongations which reach out into those of the surrounding connective-tissue capsule. Between the latter capsule and the cell is a rather roomy space, and there is also a much narrower one between the substance of the cell and its own epithelial covering. The arterial blood enters by an afferent vessel into the pericellular space and leaves it by a much narrower efferent vessel. The blood thus surrounds the cell under pressure and its liquid portions pass actively by osmosis into the substance of the cell itself, in the centre of which they are received by an empty space. This empty space is nothing else than what has so long been regarded as the nucleus of the cell. This space belongs to the venous system with which it is in connection by a minute vessel having its own proper wall. A solid body, hitherto called the nucleolus, is suspended fixed in the centre of the nuclear cavity.—*Comptes Rendus, 1885, p. 826.*

Pasteur's Method for the Prevention of Hydrophobia.—In the *Comptes Rendus* for October, 1885, is the latest report of Pasteur's experiments upon the prophylaxis of hydrophobia. The following is an outline of his procedure: When a small particle of the spinal cord of a dog dead from rabies (*moelle rabique*) is placed under the dura mater of a rabbit the animal always falls a victim to hydrophobia after a period of incubation which lasts some fifteen days. When virus from the first rabbit is transferred in the same way to a second and, after the period of incubation is

passed, that from the second to a third rabbit and so on, the duration of the period of incubation becomes more and more reduced. After the successive inoculation of twenty to twenty-five rabbits, the time of incubation is reduced to some eight days, and the incubation period remains of this length throughout a further series of twenty to twenty-five successive inoculations; then the time of incubation is shortened to seven days, which is maintained with remarkable regularity throughout a new series of ninety inoculations. Pieces of the spinal cords of these rabbits induce hydrophobia with constant virulence. When the diseased cord is detached from a rabbit under the strictest precautions against contamination by impurities, and is suspended in a flask, the air of which is kept dry by caustic potash on the bottom, its virulence gradually disappears and may become wholly lost. The virulence fails somewhat more slowly the larger the piece of marrow exposed, and is preserved longer the lower the temperature. These facts being established, the following procedure proved successful in rendering dogs resistant to the influence of inoculation with the most potent virus. Pieces of spinal marrow from rabbits dead of hydrophobia which had appeared after seven days' incubation, were suspended in a series of flasks the air in which was maintained dry. As stated above, the virulence of each specimen diminished progressively with its exposure. Sterilized bouillon was inoculated with a small portion of cord which had been exposed for such a time that the loss of its virulence was certain, and a small syringe full was injected under the skin of a dog. On each day following a similar operation was performed, using, however, at each injection, spinal cord which had been exposed for a shorter time and which possessed, therefore, progressively increasing virulence. When this procedure had been repeated until the dog had received an injection of virus which had been exposed to dry air only one or two days, the animal was found to be perfectly protected against hydrophobia, and might with impunity be inoculated with the strongest virus. Fifty dogs were thus made resistant to the disease without a single failure, besides which a number were successfully inoculated after having been bitten by rabid animals. A child which had been lacerated by a mad dog two days before and whose wounds had been cauterized with carbolic acid two hours after the injury, was brought to Pasteur for treatment. The method pursued was similar to that described, and the final inoculation was with virus more virulent than that of ordinary rabies. Three months and three weeks after the accident the child was still well. Pasteur explains his results by supposing that the products formed by the vital activity of the germs of the disease are poisonous to the germs themselves. These products are gradually set free by the action of the "attenuated" virus, and accumulate in the body in sufficient quantities to render the development of the strongest virus impossible.

PSYCHOLOGY.

Sir J. Lubbock on the Intelligence of the Dog.—Before a crowded sitting of the biological section of the British Association, Sir John Lubbock read a paper in which he gave some interesting notes on the intelligence of the dog. The man and the dog, he said, have lived together in more or less intimate association for many thousands of years, and yet it must be confessed that they know comparatively little of one another. That the dog is a loyal, true, and affectionate friend must be gratefully admitted, but when we come to consider the psychical nature of the animal, the limits of our knowledge are almost immediately reached. I have elsewhere suggested that this arises very much from the fact that hitherto we have tried to teach animals rather than to learn from them—to convey our ideas to them rather than to devise any language or code of signals by means of which they might communicate theirs to us. The former may be more important from a utilitarian point of view, though even this is questionable, but psychologically it is far less interesting. Under these circumstances, it occured to me whether some such system as that followed with deaf-mutes, and especially by Dr. Howe with Laura Bridgman, might not prove very instructive if adapted to the case of dogs. I have tried this in a small way with a black poodle named Van. I took two pieces of card-board, about ten inches by three inches, and on one of them printed in large letters the word "food," leaving the other blank. I then placed two cards over two saucers, and in the one under the "food" card put a little bread and milk which Van, after having his attention called to the card, was allowed to eat. This was repeated over and over again till he had had enough. In about ten days he began to distinguish between the two cards. I then put them on the floor and made him bring them to me, which he did readily enough. When he brought the plain card I simply threw it back, while when he brought the "food" card I gave him a piece of bread, and in about a month he had pretty well learned to realize the difference. I then had some other cards printed with the words "out," "tea," "bone," "water," spelt phonetically so as not to trouble him by our intricate spelling, and a certain number also with words to which I did not intend him to attach any significance, such as "nought," "plain," "ball," &c. Van soon learnt that bringing a card was a request, and soon learned to distinguish between the plain and printed cards; it took him longer to realize the difference between words, but he gradually got to recognize several, such as food, out, bone, tea, &c. If he was asked whether he would like to go out for a walk, he would joyfully fish up the "out" card, choosing it from several others and bring it to me, or run with it in evident triumph to the door. I need hardly say that the cards were not always put in the same places. They were varied quite indiscriminately and in a great variety of positions. Nor could the

dog recognize them by scent. They were all alike, and all continually handled by us. Still I did not trust to that alone, but had a number printed for each word. When for instance, he brought a card with "food" on it, we did not put down the same identical card, but another bearing the same word; when he had brought that a third, then a fourth, and so on. For a single meal, therefore, eighteen or twenty cards would be used, so that he evidently is not guided by scent. No one who has seen him look down a row of cards and pick up the one he wanted could, I think, doubt that in bringing a card he feels he is making a request, and that he can not only distinguish one card from another, but also associate the word and the object. This is, of course, only a beginning, but it is, I venture to think, suggestive, and might be carried further, though the limited wants and aspirations of the animals constitute a great difficulty. My wife has a very beautiful and charming collie, Patience, to which we are much attached. This dog was often in the room when Van brought the "food" card, and was rewarded with a piece of bread. She must have seen this thousands of times, and she begged in the usual manner, but never once did it occur to her to bring a card. She did not touch or indeed even take the silghtest notice of them. I then tried the following experiment: I prepared six cards about ten inches by three inches, and colored in pairs—two yellow, two blue, two orange. I put three of them on the floor, and then holding up one of the others, endeavored to teach Van to bring me the duplicate. That is to say that if the blue was held up, he should fetch the corresponding color from the floor; if yellow, he should fetch the yellow, and so on. When he brought the wrong card he was made to drop it, and return for another till he brought the right one, when he was rewarded with a little food. The lessons were generally given by my assistant, Miss Wendland, and lasted half an hour, during which time he brought the right card on an average about twenty-five times. I certainly thought that he would soon have grasped what was expected of him. But no. We continued the lessons for nearly three months, but, as a few days were missed, we may say ten weeks, and yet at the end of the time I cannot say that Van appeared to have the least idea what was expected of him. It seemed a matter of pure accident which card he brought. There is, I believe, no reason to doubt that dogs can distinguish colors; but as it was just possible that Van might be color blind, we then repeated the same experiment, only substituting for the colored cards others marked repectively I, II and III. This we continued for another three months, or say, allowing for intermission, ten weeks, but to my surprise entirely without success. I was rather disappointed at this, as, if it had succeeded, the plan would have opened out many interesting lines of inquiry. Still, in such a case, one ought not to wish for one result more than another, as of course the object of all such experiments is

merely to elicit the truth, and our result in the present case, though negative, is very interesting. I do not, however, regard it as by any means conclusive, and should be glad to see it repeated. If the result proved to be the same, it would certainly imply very little power of combining even extremely simple ideas. I then endeavored to get some insight into the arithmetical condition of the dog's mind. On this subject I have been able to find but little in any of the standard works on the intelligence of animals. Considering, however, the very limited powers of savage men in this respect—that no Australian language, for instance, contains numerals even up to four, no Australian being able to count his own fingers even on one hand—we cannot be surprised if other animals have made but little progress. Still, it is surprising that so little attention should have been directed to this subject. Leroy, who, though he expresses the opinion that "the nature of the soul of animals is unimportant," was an excellent observer, mentions a case in which a man was anxious to shoot a crow. "To deceive this suspicious bird, the plan was hit upon of sending two men to the wash-house, one of whom passed on, while the other remained; but the crow counted and kept her distance. The next day three went, and again she perceived that only two retired. In fine, it was found necessary to send five or six men to the watch-house to put her out in her calculation. The crow, thinking that this number of men had passed by, lost no time in returning." From this he inferred that crows could count up to four. Lichtenberg mentioned a nightingale which was said to count up to three. Every day he gave it three meal-worms, one at a time; when it had finished one it returned for another, but after the third it knew that the feast was over. I do not find that any of the recent works on the intelligence of animals, either Buchner, or Peitz or Romanes in either of his books, give any additional evidence on this part of the subject. There are however various scattered notices. There is an amusing and suggestive remark in Mr. Galton's interesting Narrative of an Explorer in Tropical South Africa. After describing the Damara's weakness in calculations, he says: "Once while I watched a Damara floundering hopelessly in a calculation on one side of me, I observed Dinah, my spaniel, equally embarrassed on the other; she was overlooking half a dozen of her new-born puppies, which had been removed two or three times from her, and her anxiety was excessive, as she tried to find out if they were all present, or if any were still missing. She kept puzzling and running her eyes over them backwards and forwards, but could not satisfy herself. She evidently had a vague notion of counting, but the figure was too large for her brain. Taking the two as they stood, dog and Damara, the comparison reflected no great honor on the man." But even if Dinah had been clear on this subject, it might be said that she knew each puppy personal-

ly, as collies are said to know sheep. The same remark applies generally to animals and their young. Swans, for instance, are said to know directly if one of their cygnets is missing, but it is probable that they know each young bird individually. This explanation applies with less force to the case of eggs. According to my bird-nesting recollections, which I have refreshed by more recent experience, if a nest contains four eggs, one may safely be taken; but if two are removed, the bird generally deserts. Here then, it would seem as if we had some reason for supposing that there is sufficient intelligence to distinguish three from four. An interesting consideration rises with reference to the number of the victims allotted to each cell by the solitary wasps. Ammophila considers one large caterpillar of *Noctura segetum* enough; one species of Eumenes supplies its young with five victims; another ten, fifteen, and even up to twenty-four. The number appears to be constant in each species. How does the insect know when her task is fulfilled? Not by the cell being filled, for if some be removed she does not replace them. When she has brought her complement she considers her task accomplished, whether the victims are still there or not. How then does she know when she has made up the number twenty-four? Perhaps it will be said that each species feels some mysterious and innate tendency to provide a certain number of victims. This would under no circumstances be any explanation, but it is not in accordance with the facts. In the genus (Eumenes) the males are much smaller than the females. Now, in the hive bees, humble-bees, wasps, and other insects, where such a difference occurs, but where the young are directly fed, it is of course obvious that the quantity can be proportioned to the appetite of the grub. But in insects with the habits of Eumenes and Ammophila the case is different, because the food is stored up once for all. Now, it is evident that if a female grub was supplied with only food enough for a male, she would starve to death; while if a male grub were given enough for a female it would have too much. No such waste, however, occurs. In some mysterious manner the mother knows whether the eggs will produce a male or female grub, and apportions the quantity of food accordingly. She does not change the species or size of her prey; but if the egg is male she supplies five, if female ten, victims. Does she count? Certainly this seems very like a commencement of arithmetic. At the same time it would be very desirable to have additional evidence how far the number is really constant. Considering how much has been written on instinct, it seems surprising that so little attention has been directed to this part of the subject. One would fancy that there ought to be no great difficulty in determining how far an animal could count; and whether, for instance, it could realize some very simple sum, such as that two and two make four. But when we come to consider how this is to be done, the problem ceases to

appear so simple. We tried our dogs by putting a piece of bread before them and prevented them from touching it until we had counted seven. To prevent ourselves from unintentionally giving any indication, we used a metronome (the instrument used for giving time when practicing the pianoforte), and to make the beats more evident we attached a slender rod to the pendulum. It certainly seemed as if our dogs knew when the moment of permission had arrived; but their movement of taking the bread was scarcely so definite as to place the matter beyond a doubt. Moreover, dogs are so very quick in seizing any indication given them, even unintentionally, that, on the whole, the attempt was not satisfactory to my mind. I was the more discouraged from continuing the experiment in this manner by an account Mr. Huggins gave me of a very intelligent dog belonging to him. A number of cards were placed on the ground numbered respectively 1, 2, 3, and so on up to 10. A question is then asked: the square root of 9 or 16, or such a sum as $6 \times 52-3$. Mr. Huggins pointed consecutively to the cards, and the dog barked when he came to the right one. Now Mr. Huggins did not consciously give the dog any sign, yet so quick was the dog in seizing the slightest indication that he was able to give the correct answer. This observation seems to me of great interest in connection with the so-called "thought reading." No one, I suppose, will imagine that there was in this case any "thought reading" in the sense in which this word is used by Mr. Bishop and others. Evidently "Kepler" seized upon the slight indication unintentionally given by Mr. Huggins. The observation, however, shows the great difficulty of the subject.

I have ventured to bring this question before the section, partly because I shall be so much obliged if any lady or gentleman present will favor me with any suggestions, and partly in hope of inducing others with more leisure and opportunity to carry on similar observations, which I cannot but think must lead to interesting results.—*English Mechanic.*

ANTHROPOLOGY.[1]

SOME MOOT POINTS IN AMERICAN ARCHÆOLOGY.—American archæological science, though continuously gathering strength, is, nevertheless, in a sense still far from manly development. There are celebrated institutions guarding with jealous care objects of inestimable worth; preëminent among these, the American Antiquarian Society (to commence with the oldest), the Smithsonian Institution, the Peabody Museum, the American Museum of Natural History, the Davenport Academy of Sciences, as well as those at Cincinnati and St. Louis; there are smaller institutions whose collections are of almost equal value to those above mentioned, and private museums filled with the richest material.

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

In the first place, though these institutions are presided over by men of great ability, there is a deplorable lack of mutual understanding and uniformity of method among them. There should be between those who hold in trust such vast treasures a better scientific method, a more wholesome comity of intercourse. In short, before we draw inferences we should know what and what kind of material we have in hand.

In the second place, investigations have been so increasingly fraught with grand results that some of the first efforts are likely to be ignored or forgotten. There are some points in the history of Squier's and Davis' work that have been misunderstood, and as the venerable authors are yet living it would seem a grateful tribute to bear them in mind. The earliest explorations of any great importance in the tumuli of the Ohio valley were made by Dr. Davis, who commenced a series of mound excavations while a student in Kenyon College from 1829 to 1833. The result of this first effort was published in some of the college papers.

Subsequently, Dr. Davis removed to Chilicothe, in the Scioto valley, celebrated for its earthworks. Here he laid out his plans for the great work which will forever be associated with his name.

After ten years of digging, plotting, mapping, and collecting, Dr. Davis was associated with Mr. Squier, and the fruit of their joint labors is the first Smithsonian contribution to knowledge, entitled "Ancient Monuments of the Mississippi Valley." When these first discoveries were made, comparatively little interest was manifested in American archæology. The objects recovered by the explorations of Squier and Davis, instead of remaining at home, were allowed to go abroad for want of a purchaser here. No one series of efforts since made approaches the latter in its detail and great results.

Recently the accuracy of the work done by Squier and Davis has been challenged, and this brings us to another phase of the question. Fully realizing the importance of criticism at any and all times, we still hold that a very important matter has been overlooked; it is this: The works of the mound-builders of a particular character or grade have not been compared with works of the same grade by their successors. If some of the best productions of artistic handicraft of the present Indians be compared with objects of a similar nature taken from the mounds it is more than doubtful if the superiority of the latter-day Indians can be substantiated. Generally woodcuts are published in this connection to show the low condition of the mound-builders' art. The cuts are copies of casts taken from inferior examples. Not one of the fine examples of mound-builders' work in hard stone has been figured in these comparisons. A few of the choicest specimens of this art are now in the possession of the Museum of Natural History, New York; others may be seen in almost every good cabinet in the country.

Now it is not a question of argument, but one of things. It is an easy matter to place things side by side, and there would be no question whatever of the superiority of mound-builders' work over that of every tribe known in historic times any where near the area occupied by them.

The pipes and other objects in hard stone should be compared not with pipes in catlinite and soapstone, but with objects in the same material.

The same is true of pottery. If we select from any or every collection the best evidences of form and finish and place by the side of them the best specimens of modern work by any tribe east of the Mississippi river there is a hopeless falling off.

Now it is but fair to infer that the people who so skilfully wrought in the hardest quartz, who made pottery in every way equal to that of the Pueblos, were not in the same grade as the tented savages whom our ancestors found upon our territory.

But the great, complicated earthworks of the mound-builders, so faithfully examined and reported by the old explorers, furnish the most important evidence of their superiority to their successors. It is true the southern Indians built mounds; but does any one seriously compare the works of the Natchez and Muskoki tribes with those of the mound-builders ? The Iroquois made stockades and enclosures, and Mr. Morgan argued thence the works in Ohio were precisely similar in function. But this opinion cannot stand.

In conclusion, we desire to emphasize the importance of that pioneer work, so extended and so valuable to science. There are not many examples of such unselfish devotion. More than one hundred mounds were carefully opened, their contents gathered and arranged, over five hundred embankments and fortifications visited and surveyed in five States, the expense being borne by Dr. Davis. The magnitude and completeness of all this can only be appreciated by examination of "Ancient Monuments," and of the treasures collected, now in Blackmore Museum, London.—*J. B. Holder.*

An important Contribution to Californian Folk-lore, linguistics and tribal topography is contained in the Bulletin of the Essex Institute of Salem, Mass. Nos. 1–3 of Vol. XVII (1885), pp. 33, and one plate. The author, Hugo Ried, wrote a series of letters from San Gabriel Mission to Mr. Coronel of Los Angeles, in 1852, concerning the Indians among whom he lived at the mission buildings. Twelve of these letters were published by Dr. W. J. Hoffman in the above periodical, together with copious notes of his own and drawings of the implements described in the letters. The subjects referred to are births, burials, food, medicine, diseases, sports and games, myths and legends, etc., all of which form interesting parallels to Father Boscana's Chirigchinich (in Robinson's Life in California, 1846). The first letter gives the Indian equivalents to the names of towns, harbors and

rancherias of the surrounding country; in letters 2, 3 and 4 are contained vocables, paradigms and the like of the San Gabriel language, which belongs to the Shoshondan family and has been variously termed Kish ("houses"), Tobikhar and San Gabriel dialect.—*A. S. Gatschet.*

KICHÉ GRAMMAR.—A short abstract of a *Kiché* grammar in Spanish, dated Santa Clara, Dec. 6, 1842, and composed by L. Aleman (pp. 26, 8vo), was sent by A. Blomme to the Congress of Americanists at Copenhagen (1883). The revises came in at so late a day that this elementary grammar could not be inserted in the Compte-rendu of that session, but the secretary ordered it to be struck off in a separate edition, a copy of which is before us. Mr. Blomme has given an historical account of the manuscript in the Compte-rendu, page 365. The grammar is written entirely in the old-fashioned way of the seventeenth and eighteenth centuries, when every missionary was sure to find the classifications and grammatic categories of Latin in any Indian language whatsoever. Aleman's Kiché cases of the noun, dative, ablative, etc., are simply postpositions connected with a noun; the verb *coh* is regarded as identical with the verb substantive, and a "subjunctive" is found to occur through all the tense-forms of this Guatemaltec language.—*A. S. Gatschet.*

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON, founded in 1879 by Dr. J. M. Toner, Professor Otis T. Mason and Col. Garrick Mallery, has just published its third volume of Transactions, extending from Nov. 6, 1883, to May 19, 1885. Among the papers included are the following, reported in full:

The Smithsonian anthropological collections for 1883. By Albert Niblack.

Discontinuities in nature's method. By H. H. Bates.

Elements in modern civilization. By J. M. Gregory.

Evidences of the antiquity of man on the site of the City of Mexico. By Wm. H Holmes.

How the problems of American anthropology present themselves to the English mind. By E. B. Tylor.

The Eskimo of Baffin land. By Franz Boas.

Seal catching at Point Barrow. By John Murdoch.

On the probable nationality of the mound-builders. By Daniel G. Brinton.

Moral and material progress contrasted. By Lester F. Ward.

The genesis of invention. By F. A. Seely.

Sinew-backed bow of the Eskimo. By John Murdoch.

From savagery to barbarism. Address by J. W. Powell, president.

Papers by Messrs. Kengla, Dorsey, Holmes, Blodgett, Thomas, Ward, Thompson, Gallaudet, Burnett, Reynolds, Howitt, Mindeleff, Matthews, Henshaw, Stevenson and Gatschet are given in abstract, but, as they will be published elsewhere in full, no mention of their contents will be made here.

Mr. Bates draws attention to the seeming chasms in nature, such

as the passage from inorganic to organic life, from invertebrate to vertebrate, the introduction of the Mammalia, and followed the question into anthropology, noticing such breaks as the advent of man, and the phenomena of the inventive faculty.

Dr. Gregory discusses the phenomena of civilization from the side of human wants.

Mr. Holmes, during a visit to Mexico, had the good fortune to witness the making of a railroad cut and other excavations which revealed three periods—the ancient, the Aztec and the modern.

Mr. Tylor's delightful address has already appeared in *Science*.

Dr. Boas spent more than a year in Baffin land among the Eskimo visited by Capt. Hall and gave a sketch of the geography and ethnology of this region.

Mr. John Murdoch, for three years attached to the signal service at Point Barrow, Alaska, described the varied uses of the seal and the methods of capture with the retrieving harpoon, with the una harpoon and with the net, the most ingenious plan of all.

Dr. Brinton's short paper refers to the connection of the mound-builders with the Shawnees.

Professor Ward draws attention to the disharmony between material progress, or the accumulation of the means of happiness, and moral progress, or the ability to adapt these means to human well-being.

Colonel Seely presented an elaborate argument to show the application of modern methods of examining inventions to the early inventions of our race. The term eurematics was introduced for the study of the processes of invention in all human activities.

Major Powell's address was an elaborate analysis of culture or the humanities into arts, institutions, languages, opinions and intellections, and the discussion of the three great culture stages, savagery, barbarism and civilization, in relation to these forms of activities.

Ethnology of Borneo.—Everybody has heard of Professor Ward, of Rochester. Well, in 1876 he sent Mr. Wm. T. Hornaday to the East Indies equipped as a collector. This journey accomplished, after two years of wandering, the explorer returned to active work in his profession. He has found leisure, however, to write one of the most charming books of travels in India and Malaysia it has been our privilege to read. In this volume, Two Years in the Jungle, will be found excellent notes on the peoples of India and a thorough study of the people of Borneo.

The Dyaks are thus divided :

Kyans. All of the center and coming to the coast along the middle of the north-east shore.
Hill Dyaks. Uplands of north-west corner back of Sarawak.
Sea Dyaks. Uplands and coast east of Hill Dyaks.
Mongol Dyaks. Away from the coast in the entire north-east region.

The entire coast on the south-east and south-west side is left undescribed.

The tribes are as follows:

KYANS.

1. Kyans proper, (Baram, Rejang.)
2. Milanaus.
3. Kanowit.
4. Ukit.
5. Bakatan.
6. Kiniahs.
7. Skapan.
8. Maloh.
9. Sibaru.
10. Jankang.
11. Behoa.
12. Long Wai.
13. Long Wahoe.
14. Modang.
15. Tandjoeng.
16. Saghai.
17. Engkaya.
18. Tring.
19. Kahajang.
20. Orang Bukkit.
21. Punan.

HILL DYAKS.

1. Serambo.
2. Singgei.
3. Sentah.
4. Selenkau.
5. Lara.
6. Bukar.
7. Engkroh.
8. Engrat.
9. Milikin.
10. Sou.
11. Brang.
12. Sabungo.
13. Sinar.

SEA DYAKS.

1. Seribas.
2. Saukarran.
3. Ballow.
4. Sibuyau.
5. Batang Ayer.
6. Lamanak.
7. Bugau.
8. Kantu.

MONGOL DYAKS.

1. Ida'an.
2. Kadydu.
3. Murut.
4. Bisaya.

THE ESKIMO OF POINT BARROW.—The hyperborean peoples of America are usually called Eskimo without reference to the locality where they are found, but there are Eskemo and Eskimo. For classification I find it convenient to divide their habitat as follows:

1. Greenland.
2. Labrador and Ungava.
3. Baffinland.
4. Mackenzie river.
5. Point Barrow.
6. Kotzebue sound.
7. Asiatic Eskimo.
8. Cape Nome.
9. Norton sound.
10. Nunivak.
11. Bristol bay.
12. Kadiak and the main land.

For each of these regions the National Museum has sufficient material to illustrate the arts of the people.

During the years 1881, 1882, 1883, Lieut. Ray, U. S. A., occupied Point Barrow with a party sent out by the Chief Signal Officer of the Army. The report of the International Polar Expedition to Point Barrow, Alaska, just issued by the Government printing office is the fruit of this enterprise. Lieut. Ray has a chapter on the inhabitants, but the linguistics and ethnology are the work of Mr. John Murdoch. Ten pages are devoted to the language of the people, Major Powell's alphabet and Introduction being followed closely. Twenty-six pages are occupied with a

minute description of the collections, nearly 2000 specimens gathered with great care. In examining carefully this list and the accompanying drawings he was struck both with the generic similarities of hyperborean art and with the specific differences due to isolation. Pottery occurs in the list; labret lancets of slate for cutting the holes in the cheek for labrets; amber-beads made by the natives, and cups of fossil ivory. Of the implements, whose general form is widely diffused, Mr. Murdoch has collected a great variety of each class, showing that among these far-off people differentiation of structure for functional ends has been carried to a high degree of perfection. The Natural History chapters, also written by Mr. Murdoch must not be overlooked by the ethnologist, inasmuch as the life history of the people is intimately connected with the restricted fauna of this region.

Mr. Murdoch will publish in the near future a minute description of the Point Barrow Eskimo, including their arts and their customs, so far as he was able to gather facts concerning them.

It is certainly refreshing to follow a man who enters upon the work of exploration after a severe training under the elder Agassiz.—*O. T. Mason.*

The Blow Tube in the United States.—In all tropical countries where the cane grows the natives have become expert in the use of the blowing tube. The Indians of the Muskoki stock living in Southern Alabama, Mississippi and Louisiana have been known since the early explorations to have been expert in the use of this weapon. The Choctaws of our day take the longest and straightest cane they can find in the brake for their tube, and short pieces of split cane for their missile One end is charred and scraped to a long slender point. The other is wrapped with a little strip of rabbit skin or a wad of cotton. With these the Choctaws are still expert in shooting rabbits, birds and fishes; for the latter using a barbed or retrieving arrow. These facts have been known and stated before, but what follows has never before, to our knowledge, been published. The Shetimasha Indians, about a hundred in all, living on a small bayou south of New Orleans, use the single barreled blow-tube precisely like that of the Choctaws, but they also have combinations of tubes, as we would say, viz., five barreled, eight barreled, &c., blow-tubes. They are made as follows: A number of tubes, in our collection ranging from five to eleven, of the same length and calibre are fastened securely together like a long pan-pipe by means of splints of split cane. The arrows are of split cane and vary at the point from the slender needle form to a broad arrow form. The butt end has a wad of cotton yarn 3 inches long fastened on like the bristles of a cylindrical brush. When the hunter wishes to use this weapon he loads his five or ten barrels and, stealing upon a flock of birds, lets drive the whole set one after another in quick succession. The superiority of such an arm over a single tube

is very great and it is singular that no other savages have ever studied it out.

The weapons herein described were presented to the National Museum by the Commissioners of the State of Louisiana at the New Orleans Exposition. At the same time many specimens of basketry and other handiwork made with great skill were forwarded. These also bear witness to the superior skill of the Shetimashas.

PHYSICAL EDUCATION OF CHILDREN. — Dr. E. Pokrovski, of Moscow, has published in Isvestia of the Society of Friends of Natural Sciences, Anthropology, etc., XIV, fascicle 1, 2, 3, a treatise on the physical education of children among different peoples and particularly in Russia. The contents of the treatise are given, not only to show the line of thought, but to present the analysis of a most interesting subject:

Chapter I. Attention paid to the protection and development of the embryo, heredity, relations of the sexes, condition of woman, consanguine marriages, polygamy and polyandry, marriage in classical antiquity, care taken of pregnant women among ancient and modern peoples.

Chapter II. Abortion and infanticide; motives: superstitions, fear of monsters, misery, etc., legislation relative to abortion and infanticide.

Chapter III. Parturition and the condition of the new born.

Chapter IV. Care relative to the umbilical cord.

Chapter V. Dwelling of the infant in the family of the parents.

Chapter VI. Care of the skin.

Chapter VII. Bathing of infants.

Chapter VIII. Cold baths and baptism, in Europe, in Thibet, &c.

Chapter IX. Dressing of infants among ancient peoples and modern savages.

Chapter. X. Dressing of Russian children.

Chapter XI. Enameling (emmaillotement).

Chapter XII. Kneading and rectification of the body of the infant.

Chapter XIII. Artificial deformation of the skull, ancient macrocephals, deformation among modern peoples, especially in Russia, Caucasia, Poland, Lapland, &c.

Chapter XIV. Influence of the infant's posture in its bed upon the deformation of the occiput, custom of bedding children among the Thracians, Macedonians, Germans and Belgians of the 16th century, and among the modern Asiatics. The form of the occiput in Russians of the Kourgans, from the craniological collections of Moscow.

Chapter XV. The cradle among different peoples.

Chapter XVI. The cradles of the Russians.

Chapter XVII. Cradles among other peoples of Russia, Tsiganis, Fins, Esths, Livonians, Laps, Poles, Jews, Lithuanians, Tcheremis, Bashkirs, Nogaï, Sarts, Kirghiz, Kalmuks, Yakuts, Buriats, Tunguses, Soïotes, Woguls, Samoides, Goldoi, Koriaks, Kamtchadals, Caucasians, etc.

Chapter XVIII. Methods of putting children in their beds, of carrying them and transporting them, dependence on climate, mode of life; bearing them on the arm, back, neck, head, hip; in bag, paniers, chests, skins, &c.; customs of the Chinese, Negroes, Hottentots, American Indians, Kamchadales, Japanese, etc., in this regard.

Chapter XIX. Amusement of the child by the mother in Russia.

Chapter XX. Accustoming the child to sit and to go on all fours.

Chapter XXI. The upright position and walking.

Chapter XXII. Importance of food.

Chapter XXIII. Suckling among various peoples, ancient and modern.

Chapter XXIV. Among the Russians.

Chapter XXV. Among other peoples of Russia.

Chapter XXVI. Ethnic mutilations of children, tattoo, depilation, piercing the nose, the ears, the lips or the cheeks; filing and removing the teeth, castration, circumcision and similar mutilations; corset, Chinese feet, high heeled boots, &c.

Chapter XXVII. Games, sports and amusements of children.

Chapter XXVIII. Treatment of the maladies of children among different peoples. Popular child medicine in Russia, Germany, England, Switzerland, Dalmatia, among the Kalmucks, Kirghiz, Caucasians, ancient Hindoos, Iranians, etc.

Chapter XXIX. Care relative to the corporeal development of children and the means employed to toughen and fortify them; seclusion of children, asceticism, horsemanship, physical and warlike training of children among savages, etc.

Chapter XXX. Role played by animals in the education of man,—cows, goats, dogs, she wolves, apes, etc.

Chapter XXXI. Physical education among the children of Russian peasants, and the results.

Chapter XXXII. Conclusions.

MICROSCOPY.[1]

OSMIC ACID AND MERKEL'S FLUID AS A MEANS OF DEVELOPING NASCENT HISTOLOGICAL DISTINCTIONS.[2]—In preparing embryological material for the microtome and the microscope, our choice of preservative fluids depends on the advantages offered in three principal directions. We inquire first of all what reagent, or combination of reagents, will best preserve the natural *form, relations* and *internal structure.* We next endeavor to ascertain which of the fluids appearing to satisfy the first point will leave the preparation in the most favorable condition for sectioning; and, finally, we have to consider the *differentiating capacity* of the fluids, and the conditions under which the highest differential effects can be obtained. This highly important quality, which belongs, in varying degree, to all hardening and staining reagents, serves two general purposes, one of which is purely histological, the other strictly embryological. In the one case, the aim is to sharpen the definition of individual elements, and to strengthen histological distinctions; in the other, the object is to demonstrate those subtle and imperceptible differences in the constitution of embryonic cells, which furnish the earliest premonitions of their histological destiny. The histologist deals with the first class of distinctions—the embryologist must deal with both. The embryologist cannot stop with the study of structure and topographical relations, as they exist in any particular stage; he is compelled to follow the entire developmental history of the cells, from their most indifferent up to their most highly specialized condition. Beginning with material more or less homogeneous in aspect, he finds it necessary to forestall development, and seeks to bring out distinctions that have not yet ripened into morpho-

[1] Edited by Dr. C. O. WHITMAN, Mus. Comp. Zool., Cambridge, Mass.

[2] Read before the American Society of Naturalists, December 30, 1885.

logical definition. In short, his task is no less than that of discovering, by chemical means, promorphological conditions, which shall reveal the destination of cells before nature has given them any definite histological stamp. The means that suffice to demonstrate fully formed tissue elements are not always identical with those required in tracing their histogenetic development. As yet we know very little about the capacity of different preservative fluids in the very important work of developing nascent histological distinctions. It is often at the expense of much time and patience that reagents are found which combine the first two qualifications we have mentioned, and the experimenter who has been so far successful too frequently flatters himself that he has reached the highest rung in the ladder of technical bliss, if his preparations admit of being "sliced like cheese or cartilage." But one requires no very large amount of knowledge of the aims, and experience in the ways and means, of embryological research, in order to understand that the investigator's art does not culminate in sections of cheese-like homogeneity. To be able, through serial sections, to lay bare each individual cell of a complicated organism is certainly a great triumph in microtomy; but such a feat may be, as it not infrequently has been, accomplished without leading to any important results, and simply because the methods of preparation have not been selected with a view to secure the needed differential effects.

Having defined a special aim in the use of embryological methods, it remains only to consider the practical side of the subject. The differential effects of most preservative fluids, when used singly, are extremely weak, and often quite inappreciable. To be of service, they must be strengthened or reinforced by some happy combination of reagents, discoverable only by experiment. Differential results are generally sought for through metallic impregnations and through various methods of staining, as double staining, multiple staining, overstaining followed by partial decoloration, etc. But I am not aware that such means alone are sufficient for the special purpose under consideration. In order to demonstrate differences, not of form, but of molecular constitution, the foundation for the desired effects must be laid in the process of hardening. Staining reagents may then serve to complete the work.

As an example of what may be accomplished in this way, I will give briefly my own experience with osmic acid and the so-called Merkel's fluid, which is a mixture in equal parts of chromic acid (¼ p. c.) and of platinum chloride (¼ p. c.). I have tested these reagents with three different classes of eggs, and have obtained important results, some of which have already been published. In the case of pelagic fish-eggs, with which my first experiments were made, the method of procedure is as follows: The eggs, with a little sea-water, are placed in a watch-glass; then, by the aid of a pi-

pette, a quantity of osmic acid (½ p. c.) equal (as nearly as one can judge) to that of the sea-water is added. At the end of from five to ten minutes, the eggs are washed quickly in clean water, and transferred to a chrome-platinum solution, differing from Merkel's mixture only in having a higher per cent of chromic[1] acid, where they may remain from one to three days. After this treatment, the blastoderm may be easily freed from the yolk, and, after a thorough washing in clear water for a number of hours, the preparation may be passed through the usual grades of alcohol, stained and sectioned, or mounted in toto. The osmic acid fixes the natural form and structural features of the egg perfectly, and the mixture of chromic acid and platinum chloride completes the work of hardening, and at the same time removes much of the brown or black color imparted by the first reagent. I have tried various other reagents after the osmic acid, but with far less satisfactory results. Picro-sulphuric acid, instead of arresting the blackening process of the osmic acid, increases it. Simple chromic acid arrests the blackening, but does not remove it (as does Merkel's fluid), and causes considerable contraction. Müller's fluid, recommended by Henneguy, is equally unsatisfactory. By this method a very marked differentiation is generally obtained as early as the sixteen-cell stage, the four central cells showing a very light brown shade, while the twelve peripheral cells have a much deeper shade. In later stages of cleavage, the distinction between central and marginal cells becomes still stronger, so that it becomes possible to trace the entire history of the origin of the so-called parablast, over which there have been so many controversies. The very difficult question as to the precise origin of the permanent entoderm is not settled by this method.

The same reagents may be successfully applied to the eggs of Clepsine; but here the mode of procedure is somewhat different, as regards Merkel's fluid. This mixture, employed at its normal strength, is allowed to work from one to two hours only. The differential effects are here very marked, extending not only to the different germ-layers, but even to cell-groups destined to form the central nervous system, the nephridial organs, larval glands, etc. None of the methods hitherto employed with these eggs has given results at all comparable with those I have mentioned.

In the case of the frog's eggs, I allow the osmic acid from twenty to twenty-five minutes, then transfer directly to the chrome-platinum solution employed with fish-eggs (twenty-four hours). The eggs are next placed in water and freed from their gelatinous envelopes by the aid of sharp needles and a dissecting microscope. After washing in flowing water for at least two hours, the eggs may be treated with alcohol and stained accord-

[1] A one per cent solution is used in place of the normal ¼ p. c. solution.

ing to desire. My experiments with these eggs have not yet been carried very far, and I can only say that the material, so far as examined, has turned out well. If the sectioning is not delayed too long, no disagreeable effects of crumbling will be experienced. —*C. O. Whitman.*

THE FUNCTION OF THE COMPOUND EYE.—It is held by Exner, Carrière, and others that the compound eye does not distinguish the *forms*, but only the *movements* of objects. The eye would thus be merely an organ of orientation, capable of recognizing differences in the intensity of light. Plateau[1] has undertaken a series of interesting experiments designed to test the validity ot this view. The method of experimentation was as follows:

A room five meters square is furnished with two windows, which face the west. The windows are provided with shutters, by means of which the room can be made dark. In each shutter a hole is cut large enough to receive a pane of ground glass. The vertical distance from the floor to the center of each glass is $1.75^{m.}$ and the horizontal distance between the centers of the two panes is $2.30^{m.}$ The amount of light admitted is regulated by means of black pasteboard diaphragms, which are fitted to slide in front of the glass. The diaphragm covering the left pane is perforated with a single hole, which is amply large to allow the insect to pass through in full flight. The size of the opening is varied by using different diaphragms. The diaphragm covering the right pane is perforated with a number of small holes, through which the insect could not pass. This diaphragm remains the same through all the experiments.

To begin with, the single opening in the left diaphragm is made 10^{cm} square, and the right diaphragm is perforated with 100 small holes, each 1^{cm} square, and separated by spaces 1^{cm} in width. The 100 holes thus represent the same surface as the large opening, but the amount of light that passes the former is considerably less than that which passes the latter. In successive experiments with different diurnal insects (Diptera, Hymenoptera, Lepidoptera, Coleoptera, &c.), the size of the hole in the left diaphragm is varied, so that the amount of light is sometimes greater, sometimes less than that of the right diaphragm.

If, under these conditions, an insect let loose at the side of the room opposite the windows, invariably flies to the large opening, then we might conclude, according to Plateau, that it distinguishes the forms of objects; but if it often makes the mistake of flying against the surface perforated with holes too small to give it passage, we may conclude that it does not distinguish form, but is guided by the intensity of the light. The experiments show that the flight is directed, in the majority of cases, towards the more intense light, and hence Plateau concludes that the

[1] Bull. de l'Acad. roy. de Belg., 3^me^ sér. t. x, No. 8, 1885.

view before stated in regard to the function of the compound eye is correct. He further announces his conviction that the simple eyes are rudimentary organs that serve no important purpose. This view rests on the fact that if the ocelli are covered with opaque black varnish, the insect guides its course in the same manner as before.

While these experiments may be said to favor the conclusion arrived at by Plateau, they do not, in my opinion, furnish decisive evidence. It would be quite within the range of possibilities, that the insect distinguished perfectly well the *forms* of both the large and small holes, without taking in the relation of its own size to that of the hole through which it sought to escape. The power to distinguish forms is not tantamount to a knowledge of relations that could only be learned by experience and reflection.

A METHOD OF BLEACHING WINGS OF LEPIDOPTERA TO FACILITATE THE STUDY OF THEIR VENATION.[1]—In the common method of destroying the scales on the wings of Lepidoptera, for the purpose of studying their venation, by means of caustic alkaline solutions, there is danger of not arresting the action at the proper moment, and consequently of destroying not only the portions which it is desirable to remove, but also the scale-supporting membrane, and even the delicate veins themselves. An application of a modification of the chlorine bleaching process, commonly used in cotton bleacheries, obviates the necessity of removing the scales, and leaves the wing perfect.

The most convenient method of applying the chlorine is as follows: The wings must first be soaked a few moments in pure alcohol in order to dissolve out the oily matter in them. If this is not done the surface of the wings acts as a repellent, and will not be moistened by an aqueous solution. When the wings have become thoroughly soaked by the alcohol they are ready to be removed to a solution of common bleaching powder. This bleaching powder is sold by druggists as "chloride of lime," but it is really a mixture of calcic hypochlorite, calcic chloride, and calcic hydrate. Ten parts of water dissolve the first two compounds, leaving nearly all the third suspended in the solution. The solution should be made with cold water, filtered, and kept in a tightly corked bottle until required for use. When the wings are transferred to this solution the bleaching commences, and in an hour or two the wings are devoid of markings, although the veins retain a light brown color. This is due to the fact that chlorine cannot quite decolorize animal matter, or any substance containing nitrogen, as it does vegetable tissue.

After the color has sufficiently disappeared from the wings they should be transferred to a wash composed of one part of

[1] G. Dimmock, Proceedings of the American Association for the Advancement of Science, Detroit meeting, August, 1875.

strong hydrochloric acid to ten parts of water. And here it may be added that in case the bleaching does not readily commence upon immersion in the bleaching solution, the action may be hastened by a previous dipping in the dilute hydrochloric acid. In the bleaching solution a crust of calcic carbonate, formed by the union of the calcic hydrate of the solution and the carbonic dioxide of the air, is deposited on the wings, and this calcic carbonate the final wash in dilute acid will remove. As soon as the calcic carbonate has disappeared, and all bubbling, consequent upon its decomposition by the hydrochloric acid, has ceased, the wings should be well soaked in pure water. They may then be secured on cards with a mucilage of gum tragacanth; or upon glass by the proper transfers, through alcohol and chloroform, to Canada balsam.

A solution of sodic hypochlorite, known as *Eau de Labarraque* or a solution of potassic hypochlorite, known as *Eau de Javelle*, when used in place of the solution of bleaching powder does not leave a deposit of calcic carbonate on the wings and thus dispense with the wash of dilute acid. A solution of zinc hypochlorite acts more delicately than a solution of sodic hypochlorite, and may be used in place of the latter, as may also solutions of aluminic hypochlorite, or magnesic hypochlorite.

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SCIENTIFIC NEWS.

— The recent meeting of the Society of Naturalists, held at Boston, December 29 and 30, will long be remembered with pleasure by those who had the good fortune to be present. The excellent plan of the founders of the society of limiting the range of the papers to the discussion of methods of teaching and research, leaves but small foothold for bores, and, indeed, the series of papers furnished an exhilarating succession of suggestive and easily grasped ideas. Most of the sessions were held in the physiological lecture-room of the new Harvard Medical School building and just adjoining the laboratory of Dr. Bowditch, which is probably unparalleled for its wealth of ingenious and effective apparatus, designed and made on the spot. The courtesies of the Harvard members of the society very agreeably occupied the hours not strictly devoted to business.

— Professor T. J. Burrill deals, in the *Botanical Gazette*, p. 334, with two mechanical effects of cold upon trees—the radial splitting of wood and bark, and the separation of bark or wood layers in a concentric way.

The first is explained by water freezing in plates parallel to the surface of an organ, and then, additions being made to the base,

crystals perpendicular to the surface will be formed. Thus the wood contracting, and the ice expanding tangentially and longitudinally (chiefly the former), radial bursting is the result. The south side of a tree is the weakest, as more water exists there, and ice is first formed. Direct observation shows that the specific gravity of sap is greater on the north side of a tree.

Concentric splitting is explained by minute ice-crystals forming with their axes perpendicular to the wood-cylinder, thus causing radial tension. Want of ripeness of tissue, in the sense of the relation of water to other constituents, is the chief predisposing cause.

— Henry W. Beyerinck has, in the *Botanische Zeitung*, examined the structure of the remarkable galls produced on the internodes of the stem of *Poa nemoralis* by the attacks of *Cecidomyia poæ*. While, under normal conditions, grasses are able to produce roots only from the nodes, these galls are clothed with a thick matting of roots produced from the pericambial layer of the internodes. When first found these roots differ in no respect from ordinary underground roots, being provided with a root-cap, and a central vascular cylinder with a few pitted vessels, but with no root-hairs. In the course of development they assume more and more the character of aerial roots, and lose their root-cap.

— Count G. de Saporta enters into an elaborate reply, in the Bulletin of the Geological Society of France (XIII, p. 179), to the theory of Nathorst that the supposed organic remains of a very early geological period are in reality the petrified impressions of the footprints of animals. He maintains that a minute examination of their structure entirely contradicts this view, and that even those about which Nathorst expresses the greatest doubt may be petrifactions of algæ in half-relief.

— Dr. F. W. Goding announces for early publication Lives of eminent economic entomologists of North America, a work to consist of about 150 parts, with plates. Price, $2.00, $2.50 and $3.00. Subscriptions to be sent to the author at Ancona, Livingston county, Illinois.

— Mr. E. T. Cresson, of Philadelphia, the well-known hymenopterist, after a long interval of forced cessation from scientific work, has returned to the study of the Hymenoptera, and is preparing a synopsis of the whole order which he intends shortly to publish.

— Dr. P. R. Uher has prepared a catalogue of the Hemiptera Heteroptera of North America. It is published by the Brooklyn Entomological Society, and can be had at the price of 50 cents of Mr. John B. Smith, U. S. National Museum, Washington, D. C.

— Professor C. E. Hamlin, assistant in charge of the Mollusca of the Museum of Comparative Zoölogy at Cambridge, died January 3d. He formerly held the chair of natural history at Waterville College, Maine.

— N. Joly, a well-known French zoölogist, died October 17, at Toulouse.

— Mr. S. H. Scudder has retired from the editorial management of *Science*, which is now edited by Mr. N. D. C. Hodges.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Society of Naturalists Eastern U. S., Dec. 29–30.—This active society numbers 130 working naturalists and geologists, and was organized for the discussion of methods of investigation and instruction, laboratory technique and museum administration, and other topics of interest to investigators and teachers of natural science. Membership is restricted to those who have done original work. The meeting was held at Boston, and was certainly not inferior in interest to those previously held.

The society chose as officers for the following year: President, G. K. Gilbert, of Washington; vice-presidents, Professor E. D. Cope and Dr. Harrison Allen, of Philadelphia, and Professor George L. Goodale, of Cambridge; secretary, S. F. Clarke, of Williams College; treasurer, Charles A. Ashburner, of Philadelphia; executive committee, Professor R. Ramsay Wright, of Toronto, Dr. C. S. Minot, of Boston.

Gilbert, G. K. Opening address.
Morse, E. S. On museum cases.
Bowditch, H. P. Demonstration of vaso-motor experiments.
Bowditch, H. P. Exhibition of model of the eye.
Wilder, B. G. On the use of alinjected sheep hearts in class practicums.
Wilder, B. G. Illustrations of the advantages of alinjection, vascular and visceral, in preserving material for dissection for class practicums and for permanent preparations.
Dwight, Thomas. Modern anatomical methods.
Mixter, S. J. Exhibition of injections.
Ernst, H. C. Cultivation of micro-organisms.
Davis, W. M. Methods of observing thunderstorms and discussing the results.
Warren, J. W. Demonstration of reaction time apparatus.
Warren, J. W. A simplified demonstration of the reaction of saliva.
Wright, R. R. Improvement on rocking microtome.
Wright, R. R. Photography as an aid to natural history illustration.
Gage, S. H. Dunnington's method of making colored diagrams, with modifications.
Wilder, B. G. Exhibition of preparations illustrating certain branch and class characters.
Oliver, Chas. A. Apparatus for the investigation of the color sense.
Comstock, J. H. A new method of arranging entomological collections.
Allen, Harrison. Exhibition of photographs in illustration of animal locomotion.
Wadsworth, M. E. Laboratory instruction in mineralogy.
Kingsley, J. S. Some photographic processes of illustration.
Hyatt, A. Museology.
Crosby, W. O. Arrangement of mineralogical collections of B. S. N. H.

Davis, W. M. Geological sections illustrating rate of deposit and thickness of formations.
Whitman, C. O. Osmic acid and Merkel's fluid in embryological research.
Farlow, W. G. Teaching biology at college.
Davis, W. M. On the use of models for instruction in geology.
Minot, C. S. Some improvements in histological technique.
Goodale, G. L. Exhibition of botanical physiological apparatus.

American Philosophical Society, May 1, 1885.—Dr. H. Allen made a communication on the tarsus of bats, etc.

May 15.—Professor H. C. Lewis presented an account of the great trap-dyke across S. E. Pennsylvania.

June 19.—Dr. A. S. Gatschet presented a paper on the Bœtheek Indians, with a vocabulary. Professor Cope presented a second continuation of researches among the Batrachia of the coal regions of Ohio; also a paper by Dr. A. C. Stokes, of Newton, N. Y., on some new hypotrichous Infusoria.

July 17.—Professor D. Kirkwood, of Bloomington, Indiana, presented a communication on the comet of 1866 and the meteors of November 14.

October 2.—Dr. F. A. Genth presented contributions from the laboratory of the University of Pennsylvania, XXIV—contributions to mineralogy. Dr. D. G. Brinton presented Polysynthesis and incorporation as characteristics of American languages. Dr. F. S. Kraus (Vienna) sent in a paper entitled Aus Bosneen en Herzegovina. Professor E. D. Cope presented a catalogue of the species of Batrachia and reptiles contained in a collection made at Pebas, Upper Amazon, by Mr. Hawkwell.

Oct. 16.—Professor Cope presented for the Transactions a paper on the species of Iguanidæ; and also for the Proceedings (1) a paper on the structure and affinities of the species of fishes from the Eocene of Wyoming Territory; (2) a report on the coal deposits near Zaculatipan, Hidalgo, Mexico; (3) an account of the structure of the brain and auditory apparatus of a theromorphous reptile.

Professor Houston made a statement as to the effect of the late explosion of 285,000 pounds of dynamite at Flood Rock, Hell Gate, N. Y., stating that in his opinion earthquakes were produced by the cooling of a heated surface.

November 20.—Dr. Brinton presented a paper on the Mangue language.

Professor Cope sent in a 13th contribution to the herpetology of tropical America.

Professor Houston sent a communication upon photography in a lightning flash during the storm of October 29, 1885, and exhibited the negatives and photographs.

Dr. Frazer presented a résumé of the proceedings of the recent International Congress of Geologists at Berlin, which he had attended as a delegate from the American Association for the Advancement of Science, with other American scientists. Dr. Frazer

exhibited a device for printing boundary lines automatically; also a track chart of the North Atlantic. Dr. Frazer also drew attention to the Geological and Geographical Dictionary of Sig. Villanova, of Pisa.

December 4.—Dr. Frazer presented a résumé of the geology of York county, Pa.

Professor Cope read a paper on the physical conditions of memory.

Biological Society of Washington, Nov. 14.—Communications: Mr. Richard Rathbun, Remarks on the Wood's Holl station of the U. S. Fish Commission; Dr. W. S. Barnard, Specimen-mounting case and method; Mr. John A. Ryder, A new and practical system of raising oysters on a large scale; Mr. Frederick True, On a spotted dolphin apparently identical with the *Prodelphinus doris* of Gray.

Nov. 28.—Communications: Dr. Theobald Smith, A simple device for storing cover-glass preparations illustrative of bacterial disease; Dr. W. S. Barnard, 1. Environmental digestion; 2. Specimen mount: tube-holders, labels and stoppers; Dr. C. Hart Merriam, The work of the U. S. Department of Agriculture in economic ornithology; Mr. Charles D. Walcott, Evidence of the loss of vital force in certain trilobites on approaching extinction; Mr. Frederick True, A new study of the American pocket rats; genus Dipodomys.

Dec. 26.—Dr. C.Hart Merriam, Contributions to North American mammalogy. 1. The genus Tamias; Mr. F. H. Knowlton, Multiplication in the Gynœcium of *Datura stramonium* L.; Professor O. T. Mason, Mutilations of the human body.

American Ornithologist Union.—The annual meeting took place at the American Museum of Natural History, in New York. The session opened on Tuesday, Nov. 17, and lasted two days. Among the members present were Messrs. J. A. Allen, R. Ridgway, W. Brewster, W. W. Cooke, O. Widmann, Dr. C. H. Merriam, A. K. Fisher, H. A. Purdie, and E. P. Bicknell. A number of papers of very great interest were read, and there was much discussion of knotty points in ornithology. One of the most interesting features of the meeting was the account by Mr. Brewster of his observations carried on at lighthouses during the season of migration. By means of these observations the speaker had penetrated deeper into some of the secrets in the life of the small night-migrating birds than any one else has yet done. His account of what he saw was most entertaining and valuable, and opens a new chapter in the history of our birds. The next annual meeting will be held in Washington, D. C.

Linnæan Society, Lancaster, Pa., Nov. 28.—Dr. S. S. Rathvon read a highly interesting paper on the Hessian fly and allied in-

sects. Dr. J. H. Dubbs read a paper on arrows and arrow makers. The paper was accompanied by a letter from A. F. Berlin, of Allentown, Pa., and illustrated by specimens of darts and arrow heads in stone made by Mr. Berlin by the process described in the letter. Dr. T. C. Porter stated that the Lancaster county herbarium of the society needed arranging, and that the plants should be poisoned in order to preserve them from destruction by the museum pest. He offered to defray the expense incident thereto, if the members would do the actual working part of the undertaking. The doctor's generous offer was accepted, and Professor J. S. Stahr, C. A. Heinitsh, and Mrs Zell, were appointed a committee to arrange and poison the specimens in the herbarium. Dr. Porter further stated that he intends revising the list of the flora of the county, correcting the nomenclature of the same and adding the new plants discovered thereto, and that when completed he will place the list in the hands of the society for publication in bulletin form. In speaking of the flora of the county, Dr. Porter stated that for rare specimens the Dillerville swamps appeared to be a veritable coast line, as it were.

New York Academy of Sciences, Dec. 7, 1885.—The Egyptian origin of our alphabet, Dr Charles E. Moldenke..

Jan. 4.—Fungi inducing decay in timber (illustrated); Mr. P. H. Dudley. (Specimens were exhibited of "scaly lentinus," *Lentinus lepideus* Fr.—the species of fungus so destructive to railway sleepers and timber of yellow pine (*Pinus australis*) in this vicinity.

Boston Society of Natural History, Dec. 2.—Mr. Frank H. Cushing described an Indian naturalist, or some Zuñi conceptions of animal and plant life; Mr. S. H. Scudder spoke of some recent important discoveries among the oldest fossil insects.

Dec. 16.—W. O. Crosby, Notes on joint-structure.

Jan. 6, 1885.—Frank H. Cushing, The mythology of the Zuñis.

Appalachian Mountain Club, Dec. 11, 1885.—Geodetic Observations from Moosilauke and Mansfield, Prof. E. C. Pickering; The tripyramid slides of 1885, written by Rev. Alford A. Butler, and Notes on the region east of Wild river and south of the Androscoggin, written by Mr. A. L. Goodrich.

Oct. 14.—Professor Gaetano Lanza, An ascent of Mount Garfield; M. V. B. Knox, Ph.D., Notes on the slide at Jefferson; Professor C. E. Fay, Was Chocorua the original Pigwacket?

Nov. 11.—Professor William M. Davis on mountain meteorology. The following papers by Mr. E. B. Cook, were read: Round mountain; An excursion over Mounts Nancy, Anderson and Lowell.

ERRATUM.

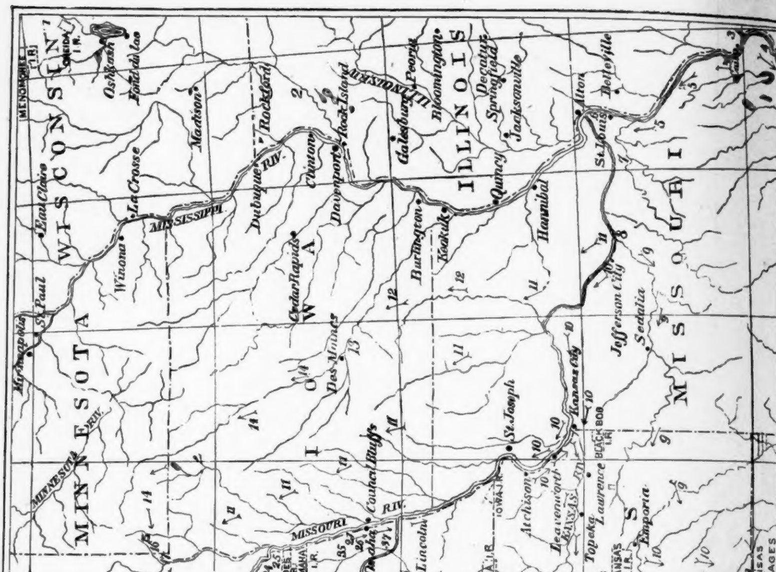
The word *of* at the middle of the last line on p. 26, January number, should be stricken out and the phrase should read:

* * * that in those species which fly most, these muscles would be relatively larger than in those of less power of flight.

Instead of:

* * * that in those species which fly most of these muscles would be, etc.

PLATE X. MAP 1.



LEGEND.—1, Winnebago habitat; 2, Iowa habitat; 3, Arkansa habitat; 4, Kwapa habitat after leaving the Omahas, etc.; 5, Omaha habitat and route after separating from the Kwapas; 6, habitat at the mouth of the Missouri; 7, course along the river; 8, habitat at mouth of Osage river; 9, course of Osages; 10, course of Kansas; 11, do. of Ponkas and Omahas (Two Crows); 12, do. of do. (according to others); 13, meeting of Iowas, Ponkas and Omahas; 14, course of the three tribes; 15, Pipestone quarry; 16, cliffs about one hundred feet high on each bank; 17, fort built by the three tribes; 18, Lake Andes; 19, mouth of White river; 20, mouth of Niobrara river; 22, Bow creek (Omaha village); 23, Ionia creek (Iowa village); 24, Ʇi-ɟañ-ga-jiñga; 25, Large village; 26, village at Bell creek; 27, course of the Iowas; 28, Omaha habitat on Salt river; 30, Ane nat'ai dha^n; 31, Ʇaɔnañguji (Shell creek); 33, village on Elkhorn creek; 35, village on Logan creek; 37, village at Bellevue.